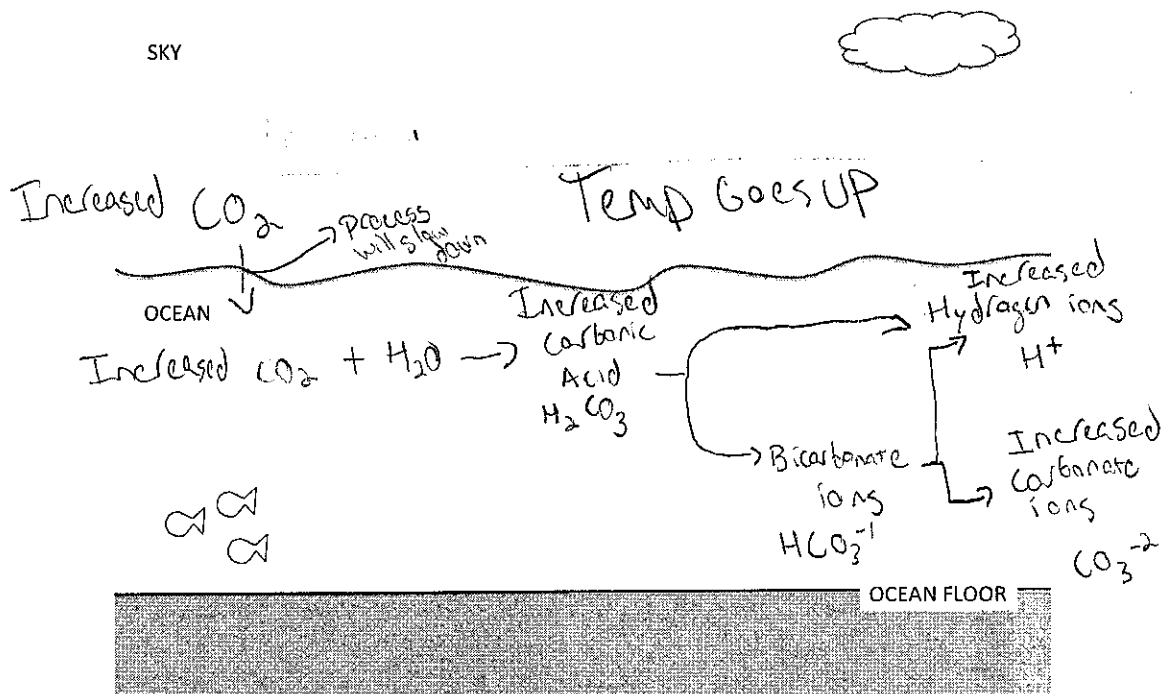


Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

When temperature is higher in the atmosphere, the amount of CO₂ in the oceans and atmosphere increased. When the temperature goes down, ^{also} the amount of CO₂ in both water and atmosphere decrease.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Colder ocean water can absorb more CO_2 , which will allow more H^+ to be formed, in turn making the oceans more acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification will be increasing as more and more CO_2 will be absorbed, but the process that this happens in, is slowed. The increased CO_2 leaves the oceans more acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

When CO_2 is increased, the temp in the atmosphere is increased, leading to a slow process, that puts more CO_2 in the oceans. This causes increased ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

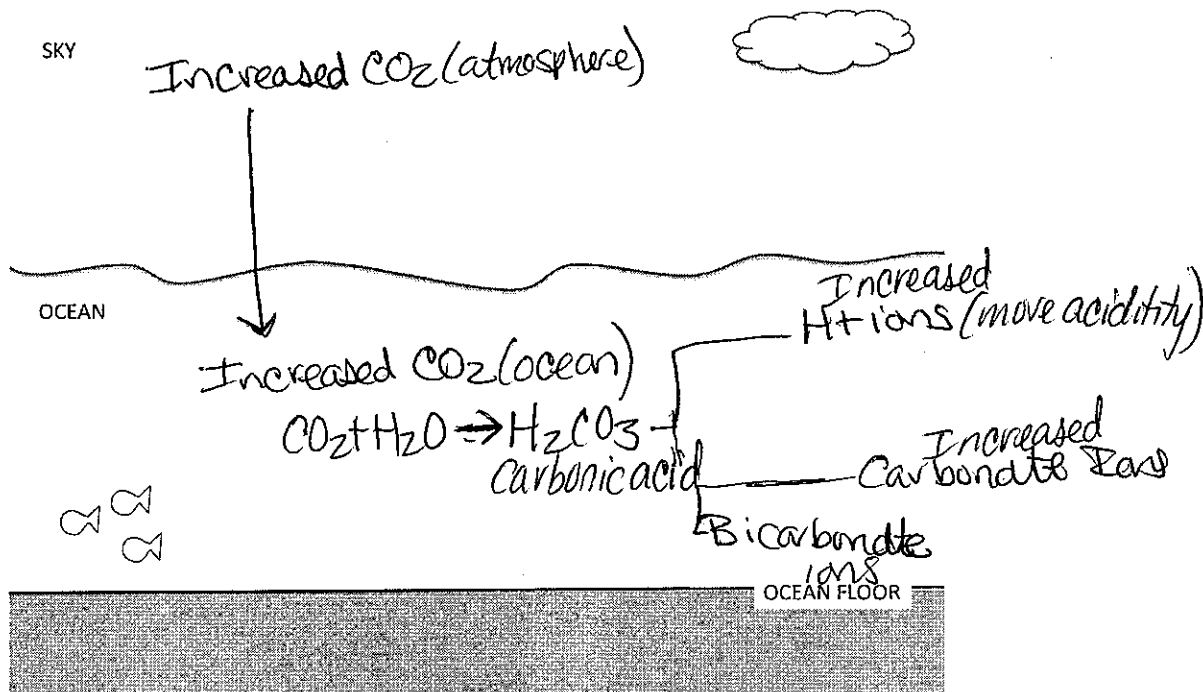
Acids in Ocean in general are not good for the human society. Also, increased amounts of CO_2 in the atmosphere and oceans can lead to problems like acid rain, global warming, etc.

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Cold water can hold more gases, which means there's more carbon in the water. This means ~~there~~ that the carbon, when water is added, turns to carbonic acid. Carbonic acid turns to hydrogen ions. ~~Colder water~~
The cooler the water, the more hydrogen ions which means more acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

More warming of the Earth's atmosphere would result in warmer oceans. Warmer oceans have faster moving molecules, which make it difficult for carbon molecules to enter, with less carbon entering, less carbonic acid turns into hydrogen ions making oceans less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

With more carbon in the atmosphere, there's a greater potential of carbon entering the ocean. With this in mind, more carbon in the ocean equals more hydrogen ions. This causes more acidity in the oceans.

D. Why do you think ocean acidification could be a problem for human society?

If the oceans become too acidic, it could harm and possibly ~~kill~~ kill plant-life & aquatic-life. This would harm human society by changing what we eat and the economy.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

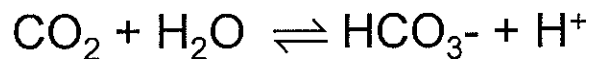
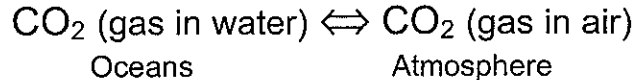
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

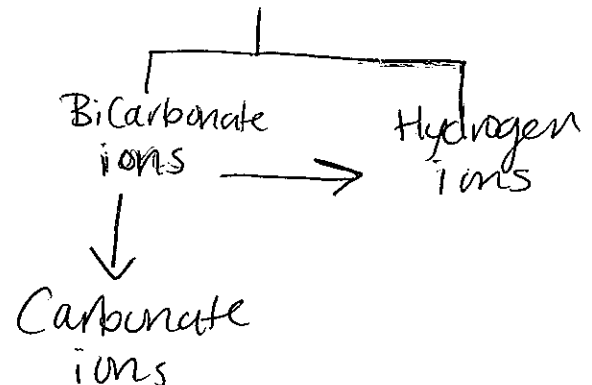
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3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Atmospheric CO₂ → dissolved CO₂ + Water = Carbonic Acid



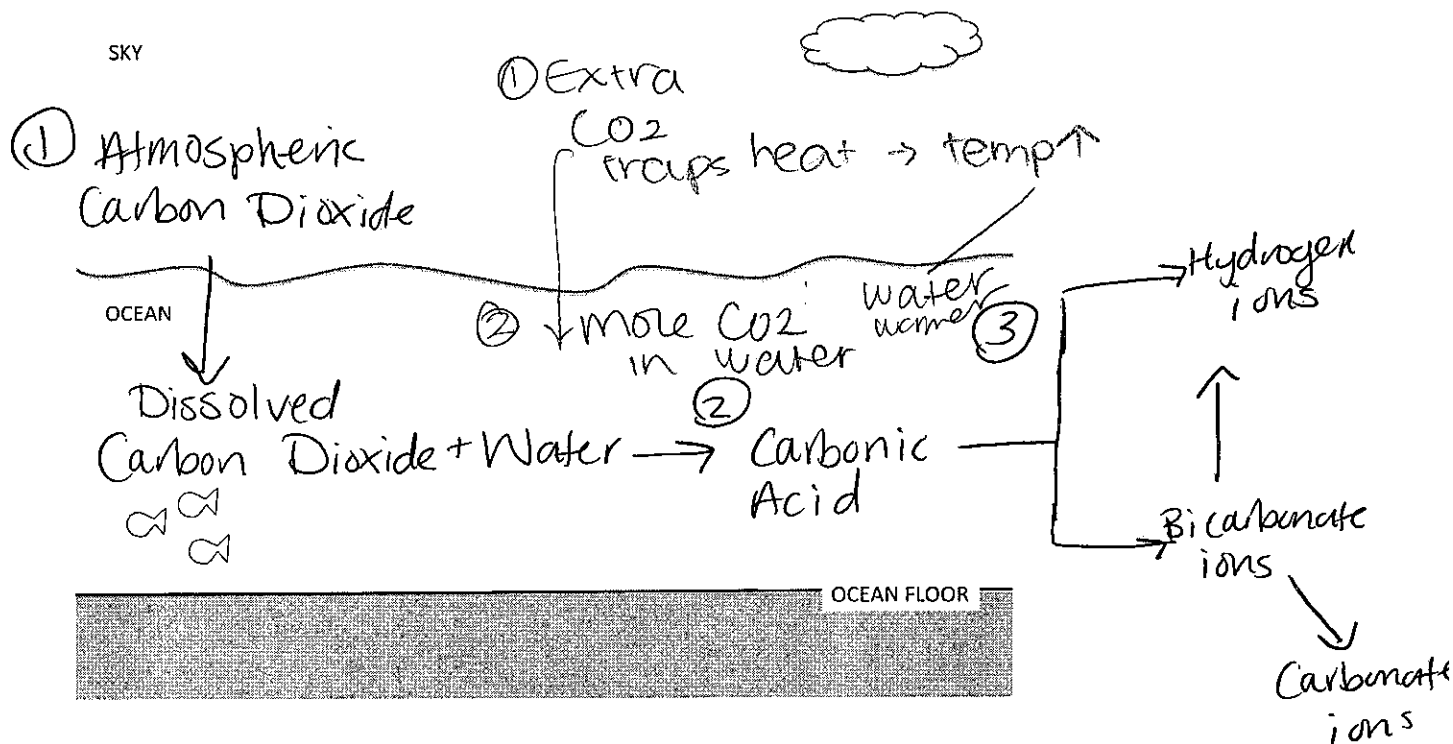
GROUP #: **C**
Student ID: **A42483118**
Members Present:
A42609057
A42226052
A42741352

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- ① Increased CO₂ in the atmosphere
- ② Increased CO₂ in the oceans
- ③ Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

CO₂ added increases temperature of water & atmosphere which reduces the rate at which CO₂ enters the water. But, CO₂ increased into the ocean leads to dissolution and the break down into hydrogen ions & carbonate ions.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the water, the more gas it can hold. The change in temperature directly affects the amount of hydrogen ions & thus acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

There would be more CO_2 released from the ocean into the atmosphere since the temperature of the atmosphere would increase, and subsequently that of the ocean which makes it less capable to hold gases.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increased CO_2 in the atmosphere traps heat and warms both the atmosphere and ocean. The result is slight increases in the CO_2 in the ocean and thus increase hydrogen ions/acidity.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification affects the shells & life of the ocean and therefore anything that is related to the food cycle/environment/food webs are negatively affected.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
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ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

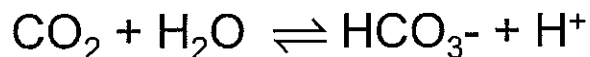
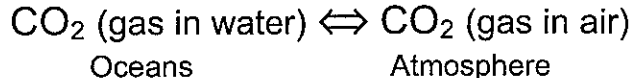
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Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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PART 1: Background Notes



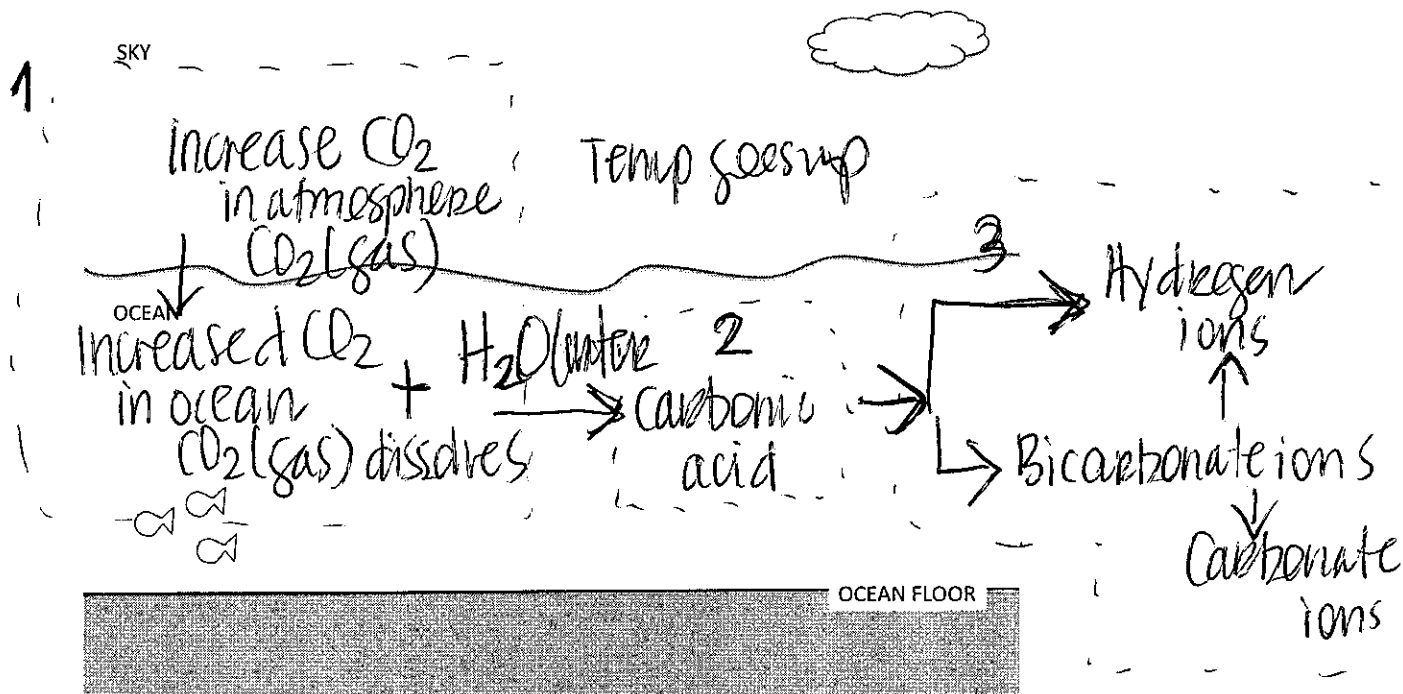
Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

- CO₂ gas decreases the pH of the ocean making it more acidic
- CO₂ & water is needed to make bicarbonate ions which is needed by organisms to make their shells
- If there is too many hydrogen ions produced from too much CO₂ in the water, the ocean water is too acidic & shells are deformed
- If there is no CO₂ in the water, no shells will be formed with the absence of bicarbonate ions
- Cold water can absorb more gases, this heats up the water & in turn makes the greenhouse atmosphere, hot water makes molecules

move faster & bounce back into the atmosphere slowing the process

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Cold water can absorb more gas molecules which makes the process of acidification happen faster, as more molecules are present, the water heats up, heats the surrounding air keeping more molecules from being able to dissolve in the water.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected? acidic water more

Water would be warmer, not able to absorb CO_2 more CO_2 would remain in atmosphere

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

more dissolved in the ocean

D. Why do you think ocean acidification could be a problem for human society?

If it is can no longer be dissolved in the ocean it will remain in the air.

Part 3: Homework

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1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

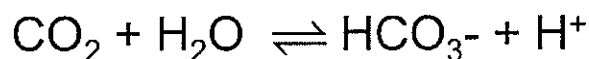
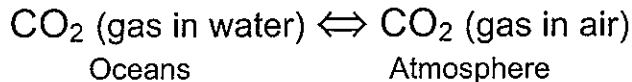
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Causal Principles

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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

GROUP #:

Student IDs of Members Present:

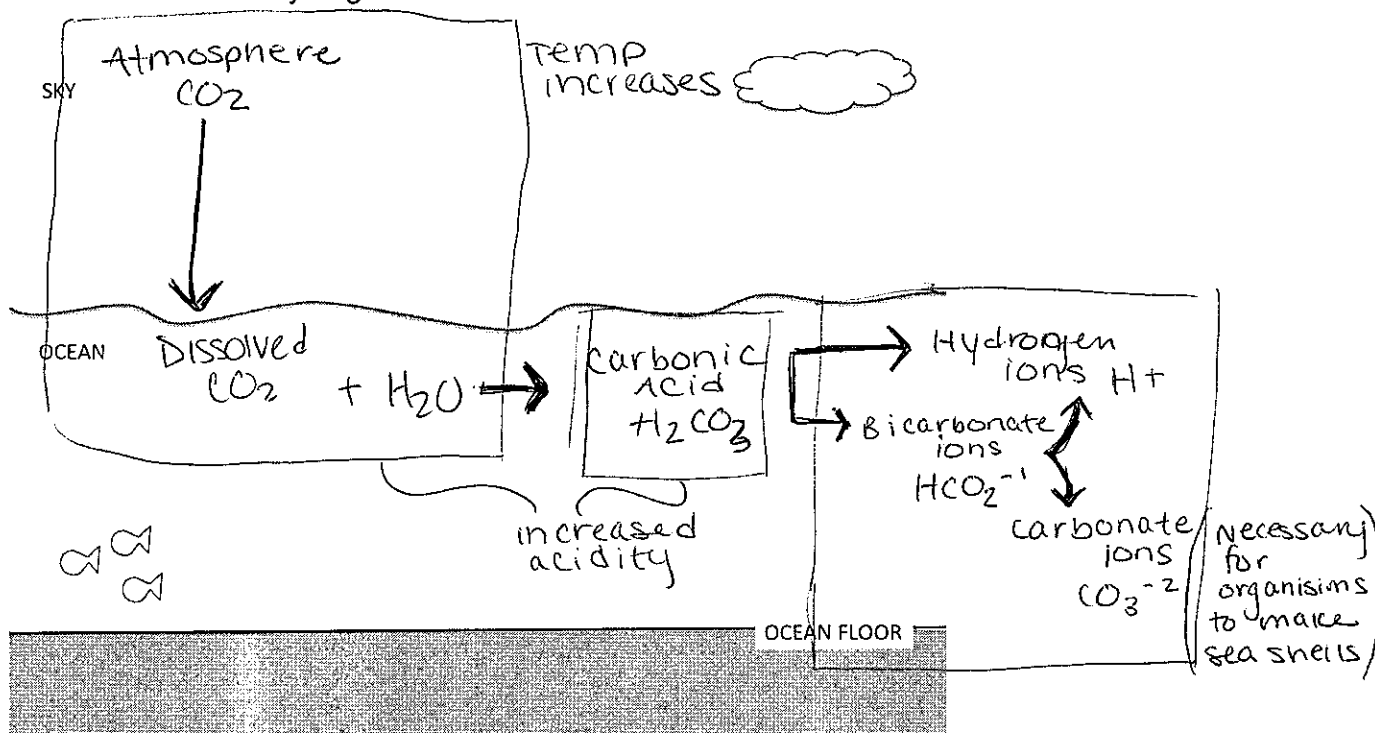
A42190700-
A39228160-
A40518681-
A41503028-

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Atmosphere & H₂O in equilibrium
so when there's more CO₂ in
atmosphere when there's more
CO₂ in water. (And less CO₂ in
atmosphere means less CO₂ in water)

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

increase in temperature increases acidity
lower temp quicken process; cold H_2O
holds more gas

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

when atmosphere is warmer, ocean
is warmer & when it's warmer
the less CO_2 it can uptake which
increases acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

increasing CO_2 increases temp in
atmosphere as well as in the ocean
which higher temp increases acidification.

D. Why do you think ocean acidification could be a problem for human society?

marine life would die if it got too
acidic which in turn affects human
society.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

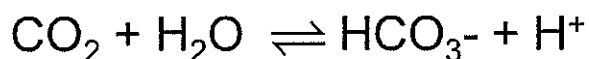
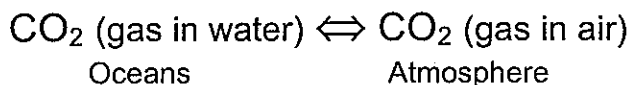
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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PART 1: Background Notes



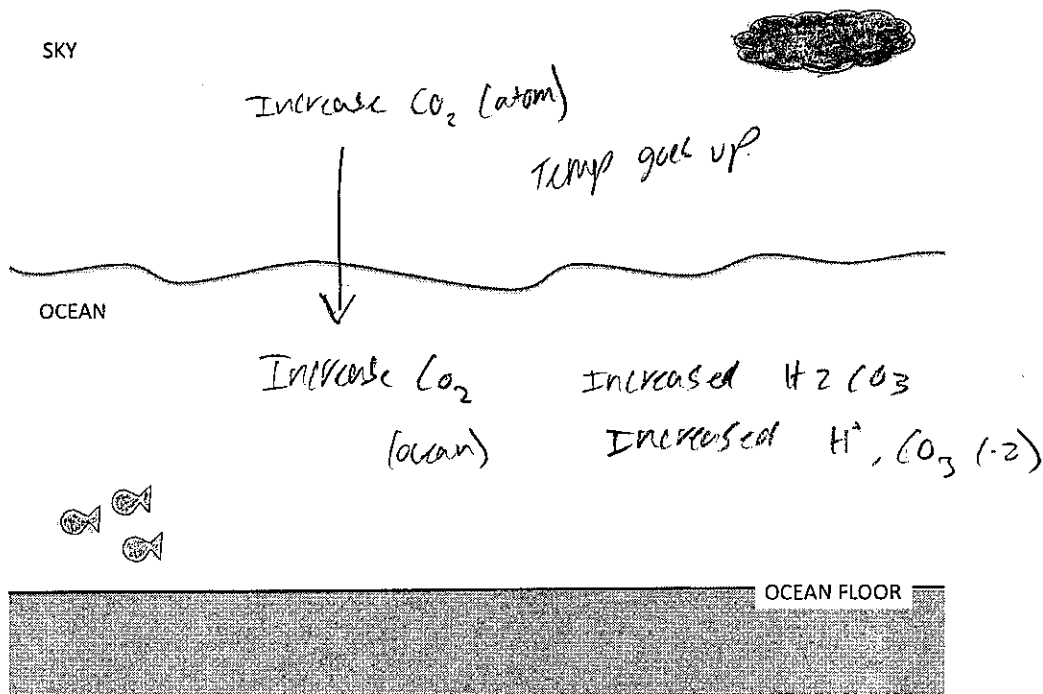
Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO_2 in the atmosphere
- Increased CO_2 in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO_2 in the atmosphere can cause changes in CO_2 in ocean water.

The CO_2 in the atmosphere falls into the ocean, causing an increase in CO_2 in the ocean.

F

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

The higher the temp. the less CO_2 the ocean can hold. the less CO_2 means less acidity \Rightarrow colder ocean temps.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Clean water heats up, the ocean acidification would decrease.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

most of the carbon dioxide falls into the oceans, causing an increase in ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

Water that's either too acidic or not acidic enough can't maintain essential living conditions for fish, organisms in the ocean.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

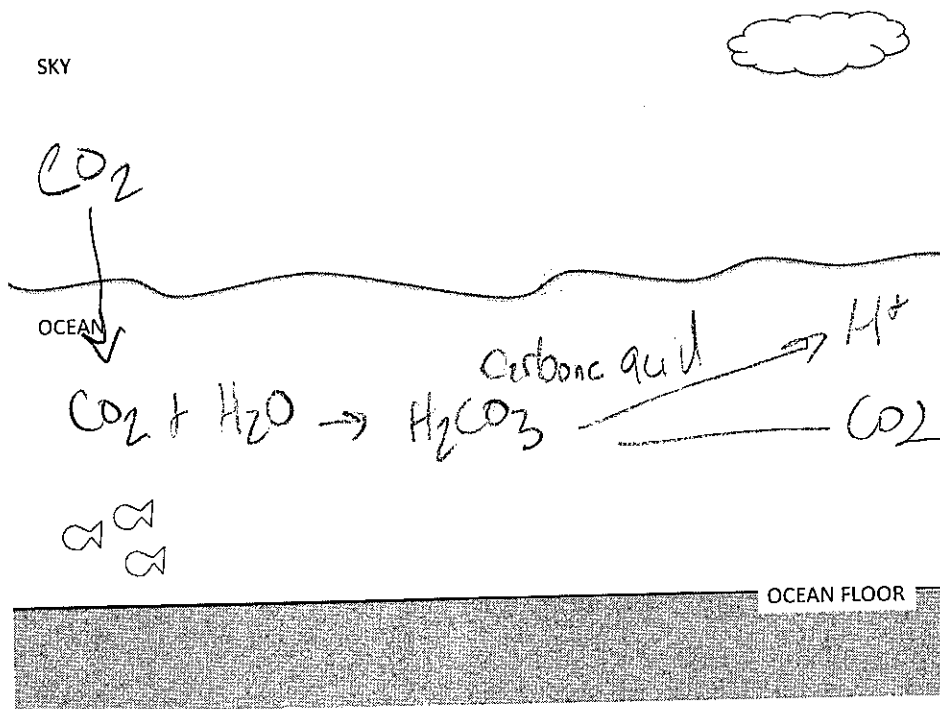
1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

More CO₂ in the atmosphere will sink into the ocean creating a chemical reaction ~~that~~ producing carbonic acid. Increasing in temp

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

An increase of temperature will increase the acidity of the ocean because it changes the amount of O_2 the water can hold.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

related
Increases the sun's shortwave radiation rays generate a hotter earth, and the green house gases will hold this heat in. A positive feedback will occur with more heat coming in and becoming trapped. When this heat is heating up the earth, the ocean will also be included and create a more acidic environment.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

CO_2 is a greenhouse gas. Increasing the amount of greenhouse gases will force the atmosphere to absorb long wave or radiation radiated from the earth's surface. This will heat the earth, making the oceans more hotter, increasing the oceans acidic environment.

D. Why do you think ocean acidification could be a problem for human society?

It is a problem for human society because the oceans biosphere is a great food source for humans. When the ocean becomes more acidic it will hurt the organisms natural habitat. ~~then~~ Coral reefs are very sensitive to acidification of the ocean. Less coral reefs will adjust the food webs changing the populations for other organisms in the ocean.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
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Objectives

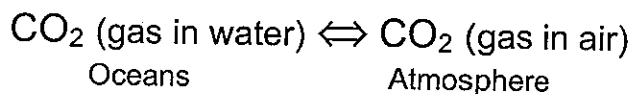
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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PART 1: Background Notes



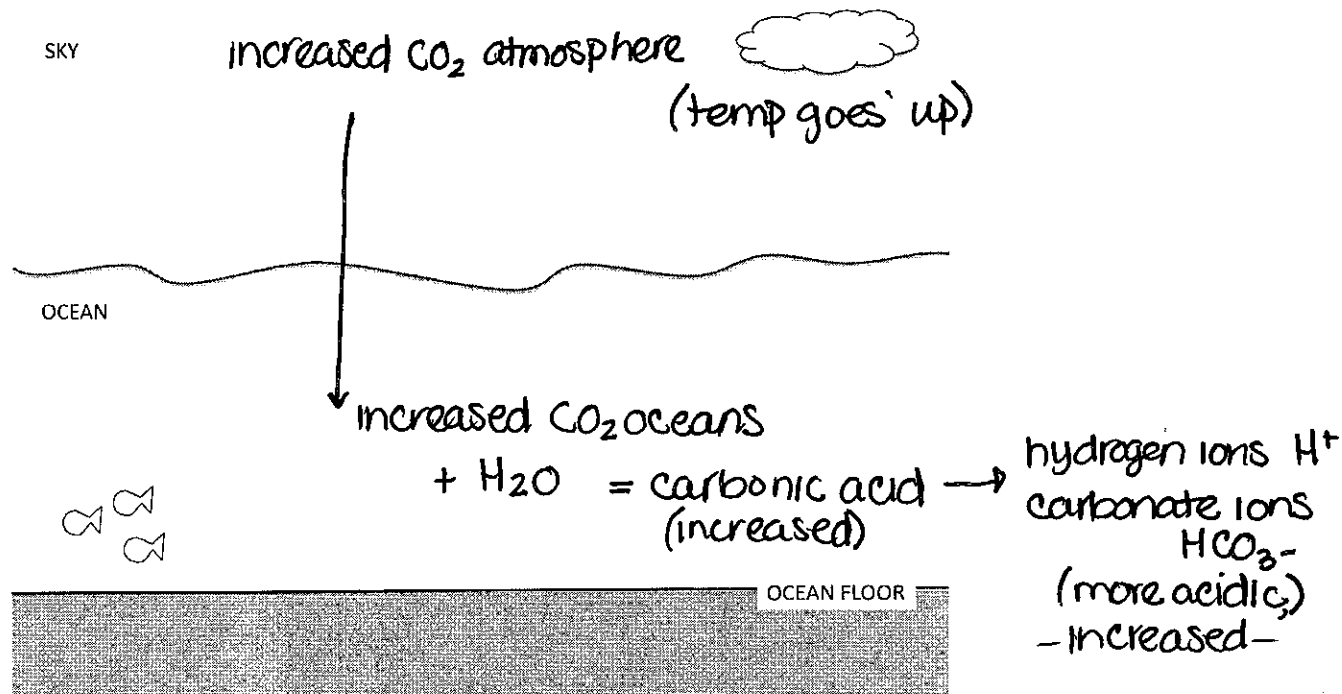
Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

increased atmospheric CO₂ means the temp. goes up and you also have increased oceanic CO₂. The oceanic CO₂ combines w/water to form more carbonic acid. This leads to hydrogen ions and carbonate ions (more acidic). If the ocean temp. goes up, the ocean can hold less CO₂ but there is still a net increase.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

A Temperature increase means that the molecules are moving faster and it is more difficult for ~~ea~~ ^(ocean) CO_2 to enter or dissolve into the ocean. So as temp goes up, the ocean acidity will increase at a slightly lower rate.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If atmospheric temp. increases, so will ocean temp. A ~~lower~~ ^{higher} ocean temp. means that the ocean can hold less CO_2 and the ocean will be less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

That would mean higher ocean acidification because the CO_2 is still seeking equilibrium. But, an increase in CO_2 (atmosphere) means a higher temp. in the atmosphere and ocean. A warmer ocean can hold less CO_2 but you would still have a net increase.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could become a problem when the levels are too high. Too much of ocean acidification would hinder the organisms of the ocean from functioning like normal.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?

Cutting down trees would mean there would be less atmospheric CO_2 and less CO_2 in the atmosphere w/o

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

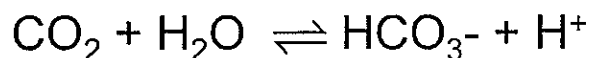
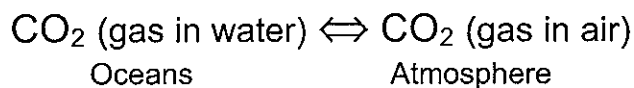
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Causal Principles

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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

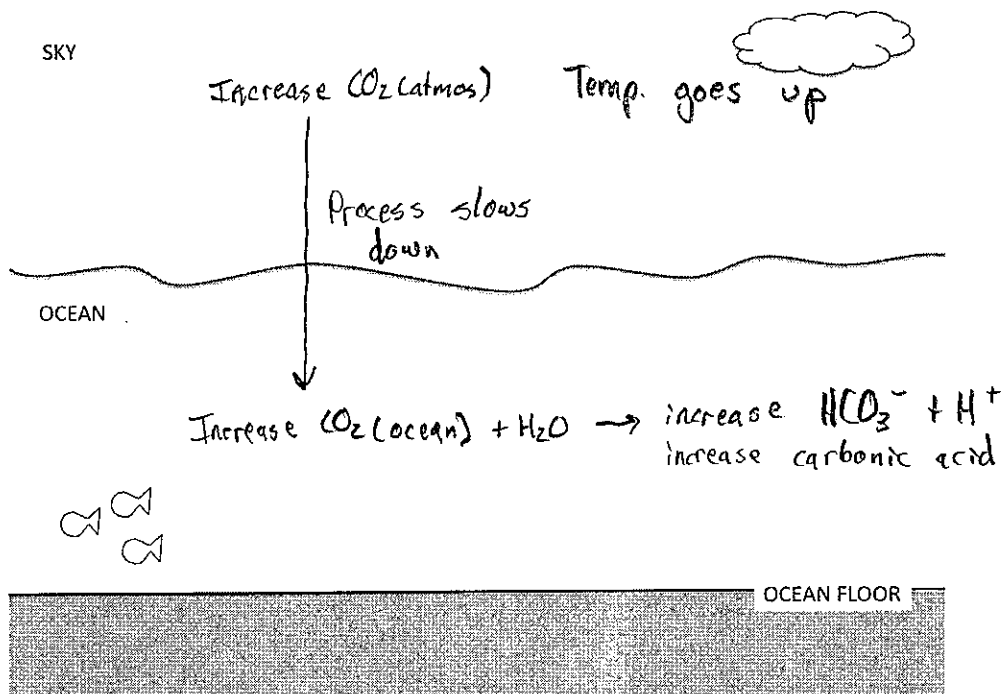
GROUP #: I
Student IDs of Members Present:
A41696110 A40840884
A40006739 A42097140

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.



Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the ocean water is, the more CO_2 it can hold, making it more acidic. More CO_2 leads to more production of carbonic acid & hydrogen ions.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

This would cause a warming of the oceans as well, which would slow down the process of CO_2 transfer to the ocean. This would cause it to be less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increasing CO_2 in the atmosphere may lead to increased acidification in the ocean because of equilibrium. The unbalance of CO_2 will cause it to transfer to the oceans. An increase of CO_2 will lead to more carbonic acid, resulting in more hydrogen ions.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could be a problem for human society because it has an effect on reefs. The loss of coral reefs would have an effect on the oceans, which many people rely on.

Part 3: Homework

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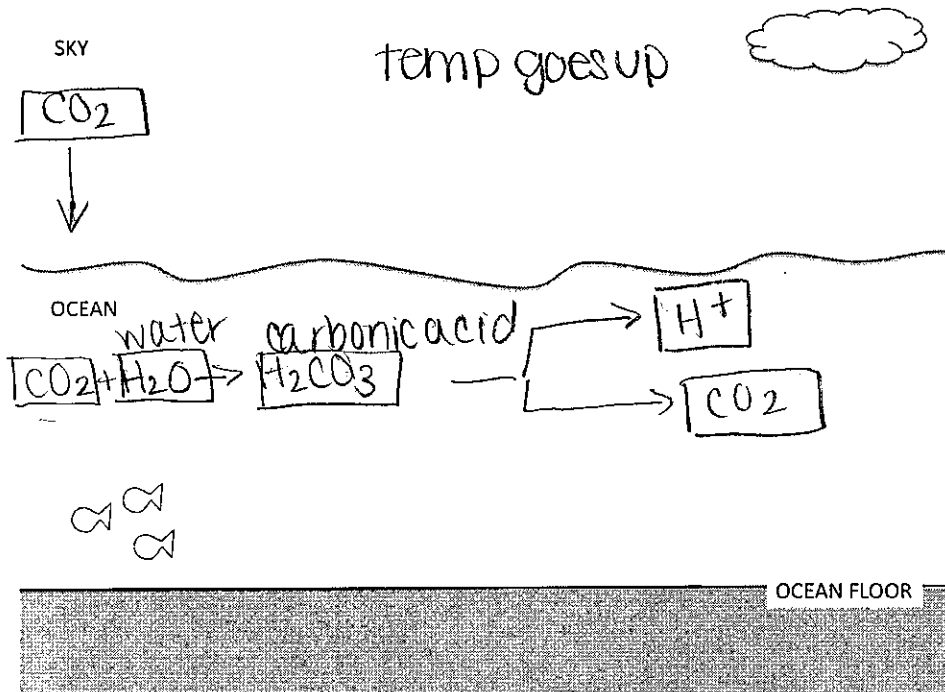
1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
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Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

changes in CO₂ in the atmosphere causes CO₂ in the water to change as well. When more CO₂ gets into the ocean, more reacts with the water to form carbonic acid. The more carbonic acid in the oceans, the more will split apart to hydrogen ions and carbonate ions. Both of these make the ocean more acidic, which hurts the ability of oceans to be able to form coral, etc.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

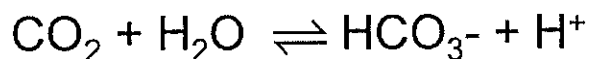
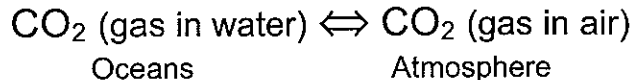
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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

cold water holds more gas than warm water and so colder temperatures quicken acidification in the oceans.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Increases in radiation waves from the sun will make the earth hotter so the greenhouse gases can hold more gas in. Holding more gas in the environment will change the amount of CO₂ produced, which will lead to more CO₂ in the oceans, making them more acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

CO₂ is one the main greenhouse gases that effects the environment. When carbon dioxide goes up in the atmosphere, the atmosphere is forced to absorb long wave radiation, which will increase the earth's temperature, since the radiation is trapped. Higher temps lead to more CO₂ entering the ocean and breaking into carbonic acids which makes oceans more acidic.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification decreases the production of coral reefs. Coral reefs are main tourism attractions, which could hurt the economy if the reefs were diminished. The reefs also protect the shores, without them, wave height and current could become dangerous.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

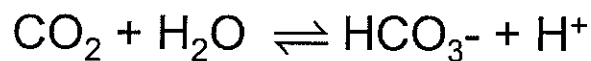
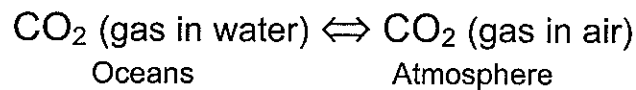
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
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PART 1: Background Notes



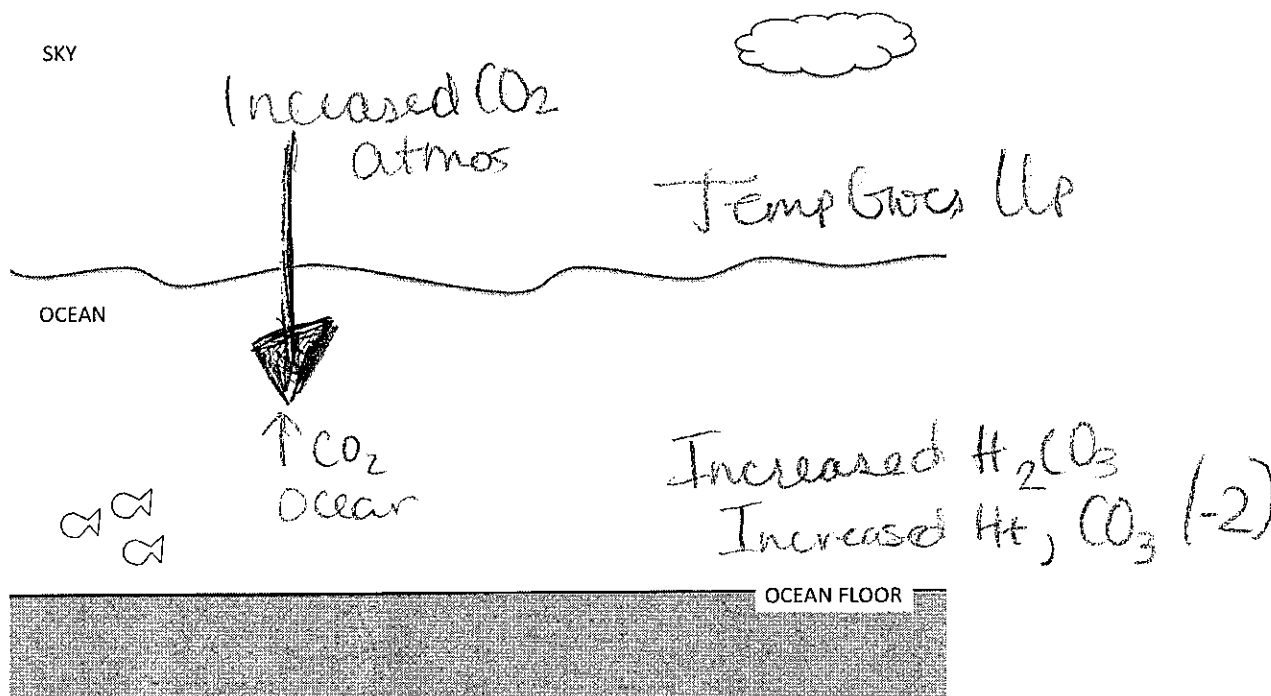
Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

It changes the acidity + pH

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

↓ pH in Ocean
↑ in atmosphere

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The CO_2 would go to ocean to equalize
 pH would increase

D. Why do you think ocean acidification could be a problem for human society?

It could hurt our fish + seafood industry.
It could prompt global warming

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

B

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

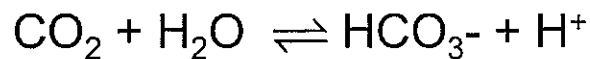
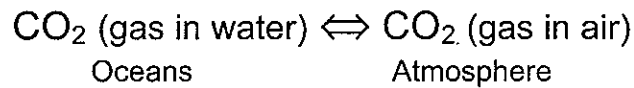
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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

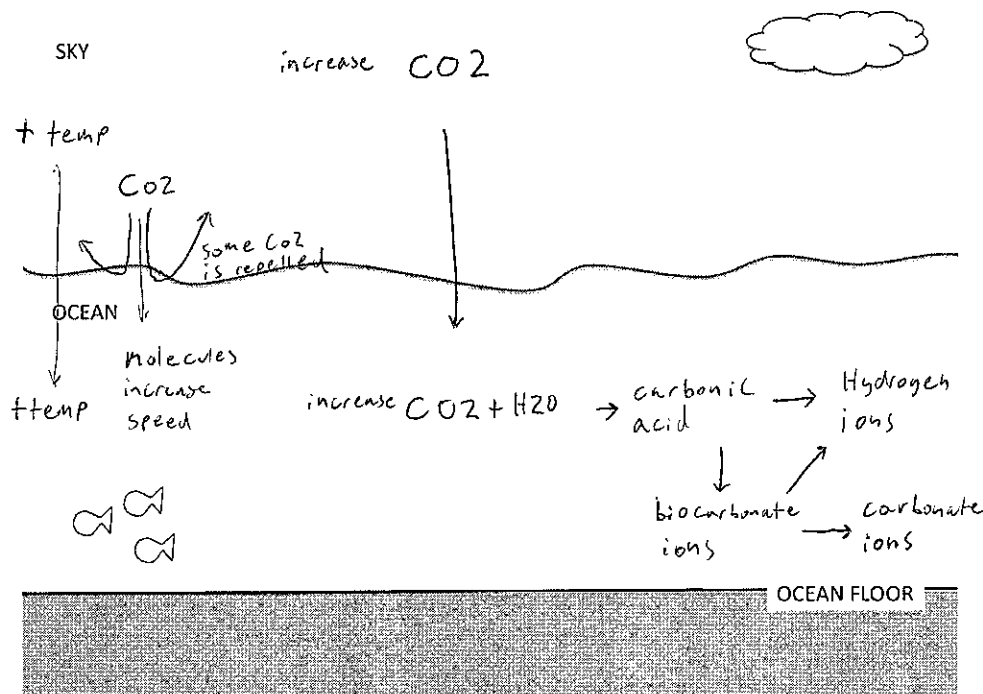
GROUP #:
Student IDs of Members Present:
[REDACTED] A43499348
[REDACTED] A41439593
[REDACTED] A42065731

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Increasing CO₂ in the atmosphere causes more CO₂ to dissolve in the ocean. More CO₂ mixes with H₂O, making more carbonic acid.

The increase in carbonic acid in the ocean slows coral reef growth.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

As temperature increases, ocean acidification increases. More CO_2 in the ocean causes more carbonic acid. A decrease in temperature would decrease acidification.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would increase because warmer atmosphere would increase CO_2 in the air, which would then dissolve and acidify the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The atmosphere and hydrosphere strive toward an equilibrium of CO_2 level. More CO_2 in the air dissolves more in the ocean. When CO_2 and H_2O mix more often, more carbonic acid results.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could effect fish populations. Fishing-based industries might face less reliable harvests.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

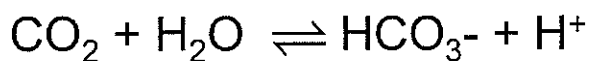
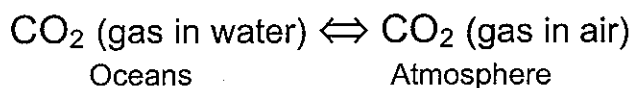
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Causal Principles

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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

M

GROUP #:

Student IDs of Members Present:

[REDACTED] A43915317

[REDACTED] A34305310

[REDACTED] A42383975

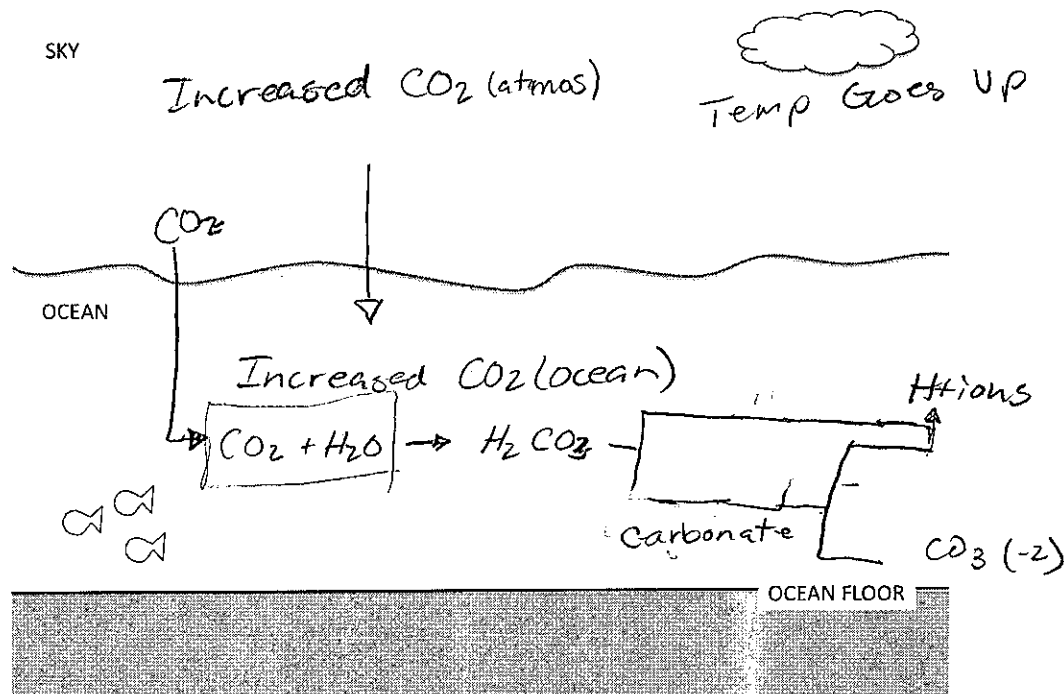
[REDACTED] A42773599

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If the amount of CO₂ in the atmosphere increases, the temperature of the atmosphere and the oceans increases and as a result oceans absorb less CO₂

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

The warmer the water is the more the H_2O is moving, which makes it harder for CO_2 to dissolve because it runs into H_2O molecules before it can dissolve hence, warmer water is harder to dissolve stuff in then colder H_2O
 CO_2

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

There would be an increase of temperature in the water so since the warmer water is the harder it is to dissolve CO_2 , with less CO_2 ~~there is~~ in H_2O there is less carbonate ions and less H^+ so less acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Since there is more CO_2 in the atmosphere there will be a need for equilibrium, so more CO_2 will dissolve into the ocean to try to reach equilibrium. Since more dissolved CO_2 in water means more CO_3^{2-} and more H^+ there will be greater acidity

D. Why do you think ocean acidification could be a problem for human society?

We continue to pollute the air with CO_2 emissions and the more CO_2 in the atmosphere the more CO_2 will dissolve into the ocean to reach equilibrium as stated in the last 3 answers, more CO_2 in H_2O means more CO_3^{2-} and more H^+ which means more acid

Part 3: Homework

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1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
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ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

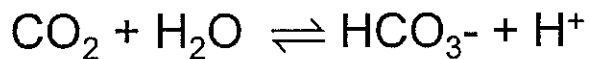
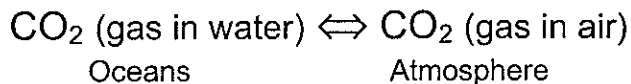
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PART 1: Background Notes



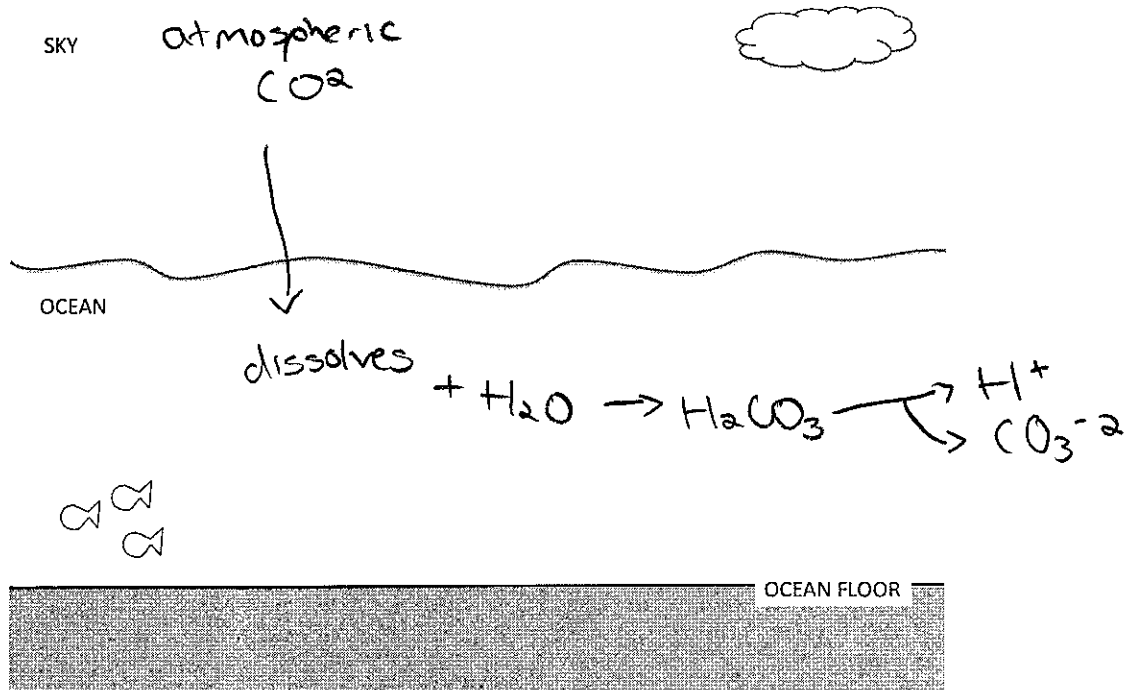
Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Atmospheric CO₂ dissolves in water, combines w/
water to break down into hydrogen + Bicarbonate
ions.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Increased temperature leads to breakdown of CO_2

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would rise

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 will dissolve in the ocean which will lead to more Hydrogen ions & bicarbonate ions

D. Why do you think ocean acidification could be a problem for human society?

It will hurt marine reproduction which means less fish for human consumption

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

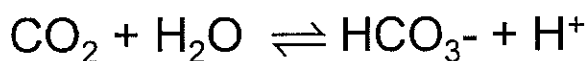
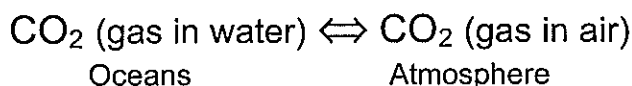
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PART 1: Background Notes



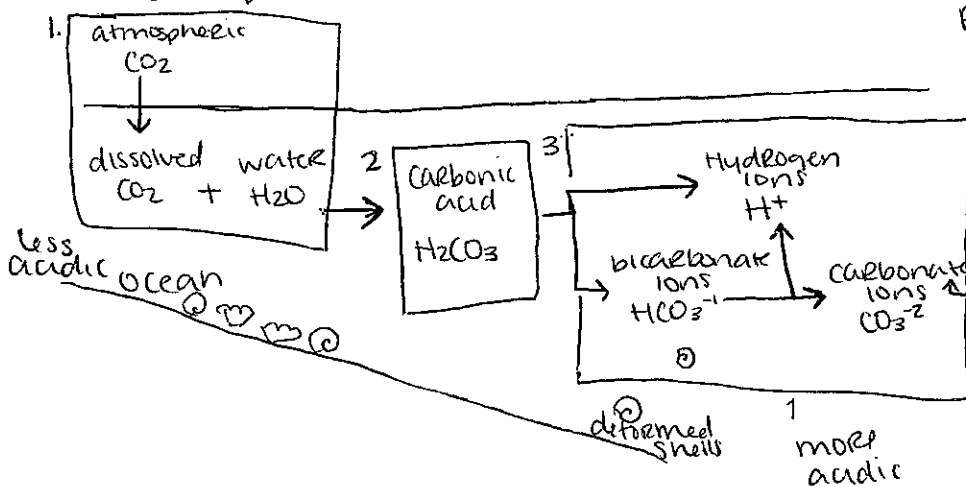
Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Input & output @ same rate = equilibrium

Semipermeable membrane → ions flow through to return to equilibrium

↳ CO₂ atmosphere, oceans

CO₂ from lake degassed to reach equilibrium into air



CO₂ doesn't break apart, gas in atmosphere & water.

pH (low) acidic = more H⁺ ions
acidity ↑ = H⁺ ↑

necessary for production of seashells
cold water holds more gas than warm water

cold H₂O absorbs more CO₂

↑ temp = slow process
↓ temp = quick process

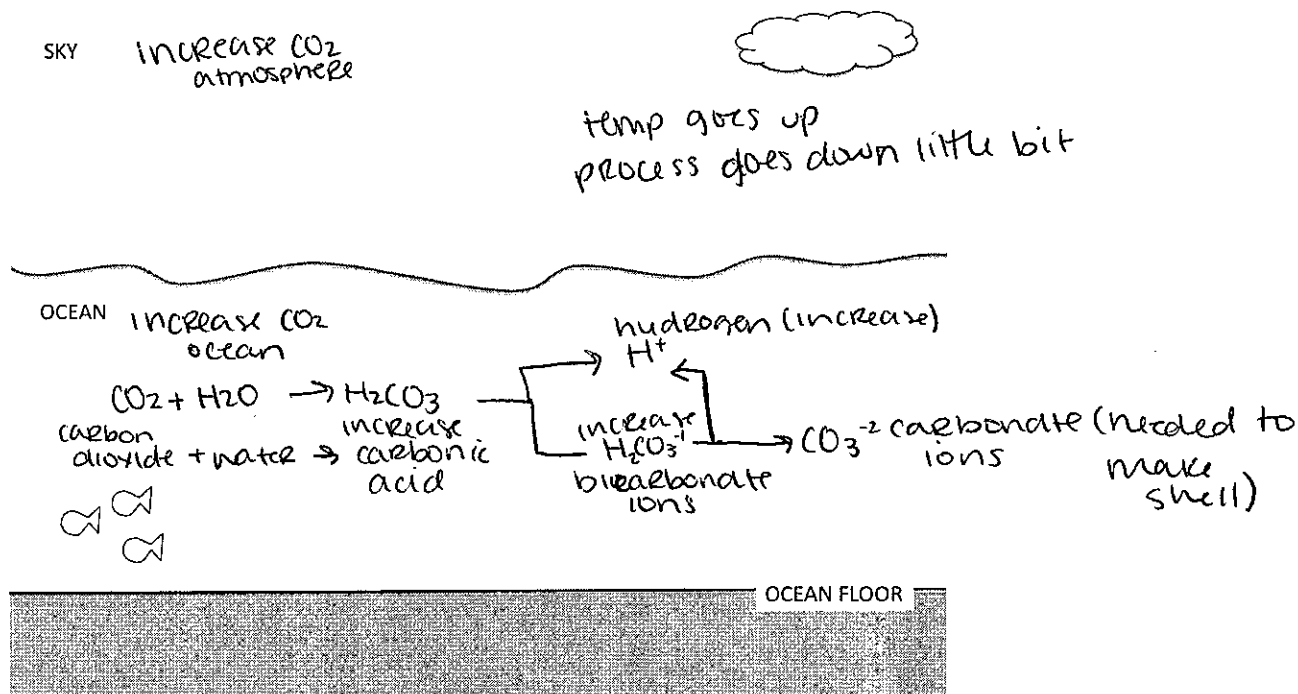
GROUP #: 0
Student IDs of Members Present:
A43643320
A41268816
A34590917

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water. the more ~~more~~ CO₂ in the atmosphere, the more CO₂ in the ocean.

Decrease CO₂ in atmosphere → decrease CO₂ in ocean

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

if the temp in the ocean is colder it will absorb more CO_2 which will increase the oceans acidity. If the oceans temp goes up it won't be able to absorb as much CO_2 & ~~the~~ the ocean won't be as acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

~~ocean~~ the process will slow down b/c the ocean's temp would go up which would decrease the amount of CO_2 absorbed & will mean there would be a decrease in ocean acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification. an ~~exp~~ increase of CO_2 in the atmosphere leads to an increase of CO_2 in the ocean which will increase carbonic acid, carbonate, hydrogen & bicarbonate levels which will increase ocean acidity.

D. Why do you think ocean acidification could be a problem for human society?

high ocean acidification leads to deformed shells which can lead to fishery breakdown which then affects a major world food source.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
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ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

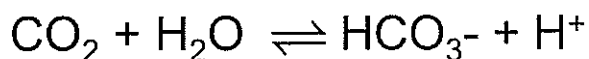
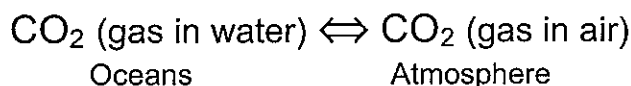
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PART 1: Background Notes



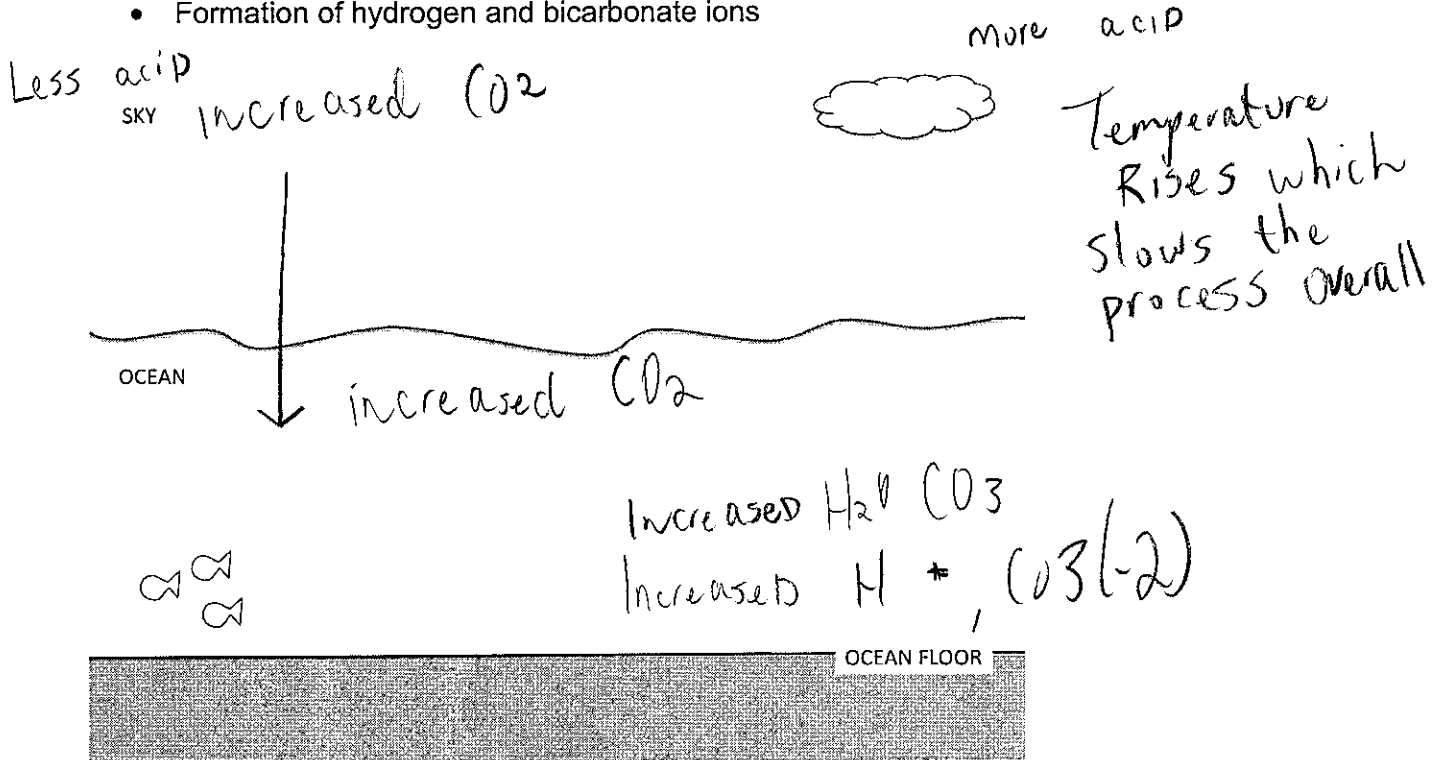
Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere ; warmer (more heat)
- Increased CO₂ in the oceans ; warmer
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

A warmer atmosphere results from increased CO₂. When this occurs, CO₂ in the ocean increases as well, but at a slower rate. Overall, increased CO₂ in the atmosphere results in increased CO₂ in ocean. Temperature increases as well.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

When the temperature in the atmosphere increases, increased CO_2 rates occur which increases both ocean temperature and CO_2 levels.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If the temperature of the atmosphere increases the ocean's temperature increases as well. When this happens, CO_2 levels in the ocean increase.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increased carbon dioxide in the atmosphere increases ocean temperature. When this happens, the process is slowed but levels of CO_2 increase.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could be problematic in that increased CO_2 levels could harm ocean life (or kill). This would effect in a negative way both ocean life, and the global economy perhaps (due to a loss of ocean resources).

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

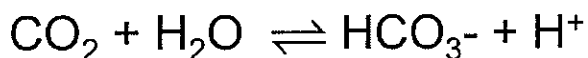
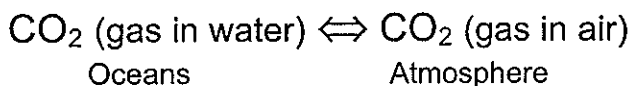
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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions



CO₂ doesn't break apart, just a gas in the water.

ISP203A – Global Change **if there is too much acidity in water, the organisms can't form great shells.*

Objectives

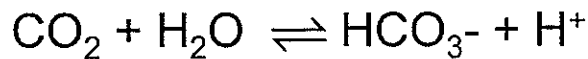
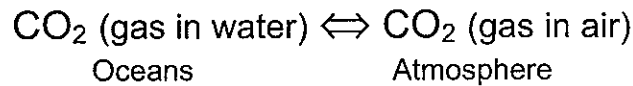
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PART 1: Background Notes



↑ temp - faster molecules

Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Carbon dioxide dissolves in water to form carbonic acid

*cold water can hold more gases than warm.

*if atmosphere gets warmer, the more CO₂ in atmosphere more CO₂ in water but the rate at which it happens slows down.

When you reduce CO₂ you replace it

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

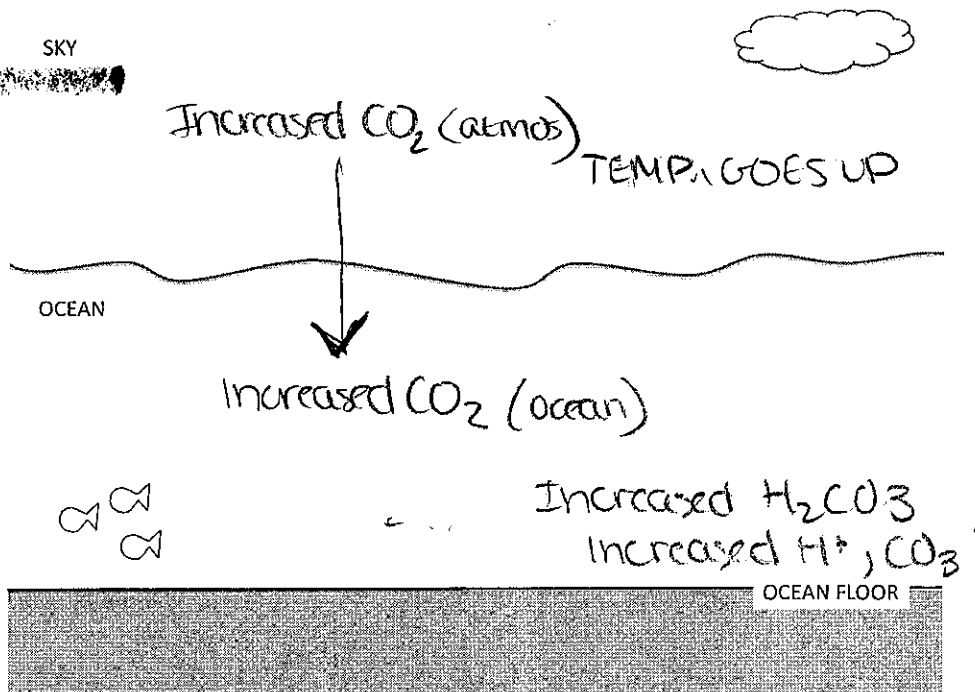
GROUP #:
Student IDs of Members Present:

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

As CO₂ increases in the atmosphere it means there is an increase in the temperature and more CO₂ in water as well. Since the water is warmer, it slows down the process of CO₂ forming carbonic acid.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

If the temperature in water increases then the amount of CO_2 increases but slows down the process of CO_2 dissolving into carbonic acid which makes it less acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean would be less acidic because the process has slowed down because CO_2 is exiting the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

When you increase CO_2 in the atmosphere it has to remain in equilibrium with the ocean therefore leading into an increase of CO_2 .

D. Why do you think ocean acidification could be a problem for human society?

The ocean acidification could be a problem for human society and kills the shells in the ocean.

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Objectives

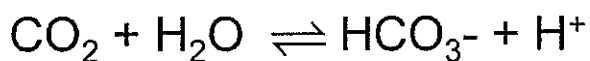
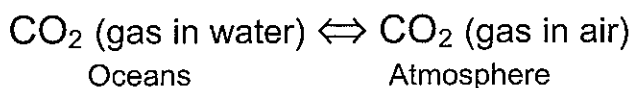
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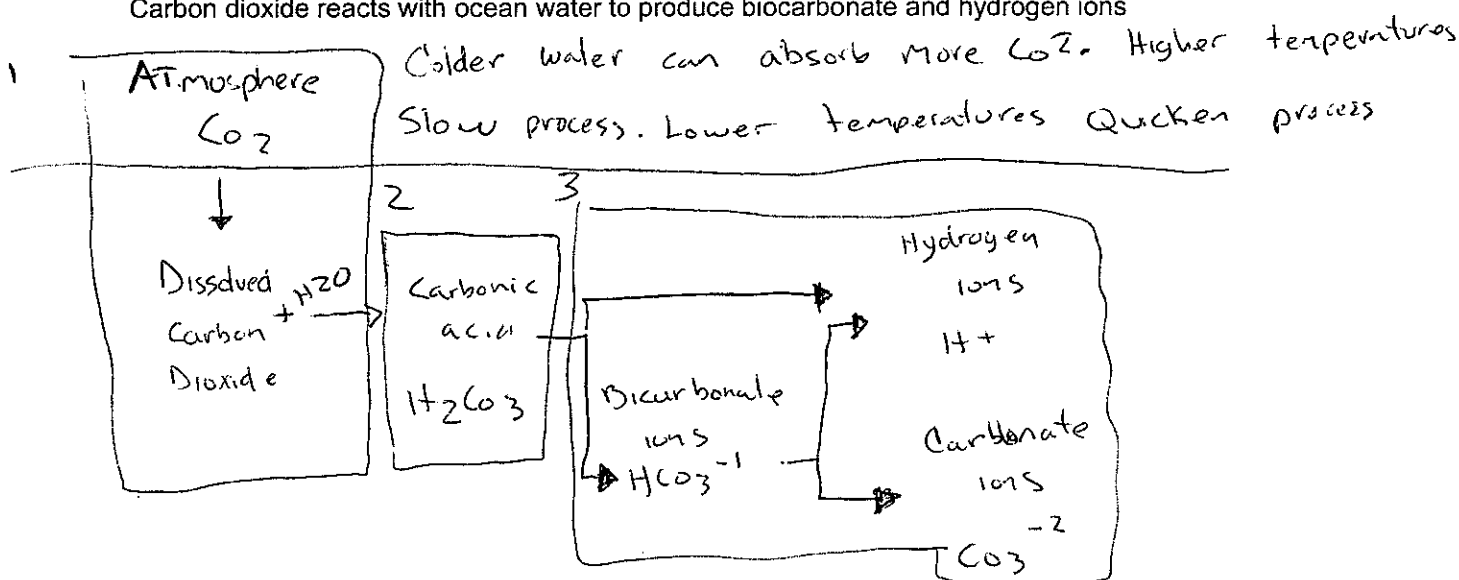
Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions



GROUP #: 5

Student IDs of Members Present:

A43294133

A13927449

A43856550

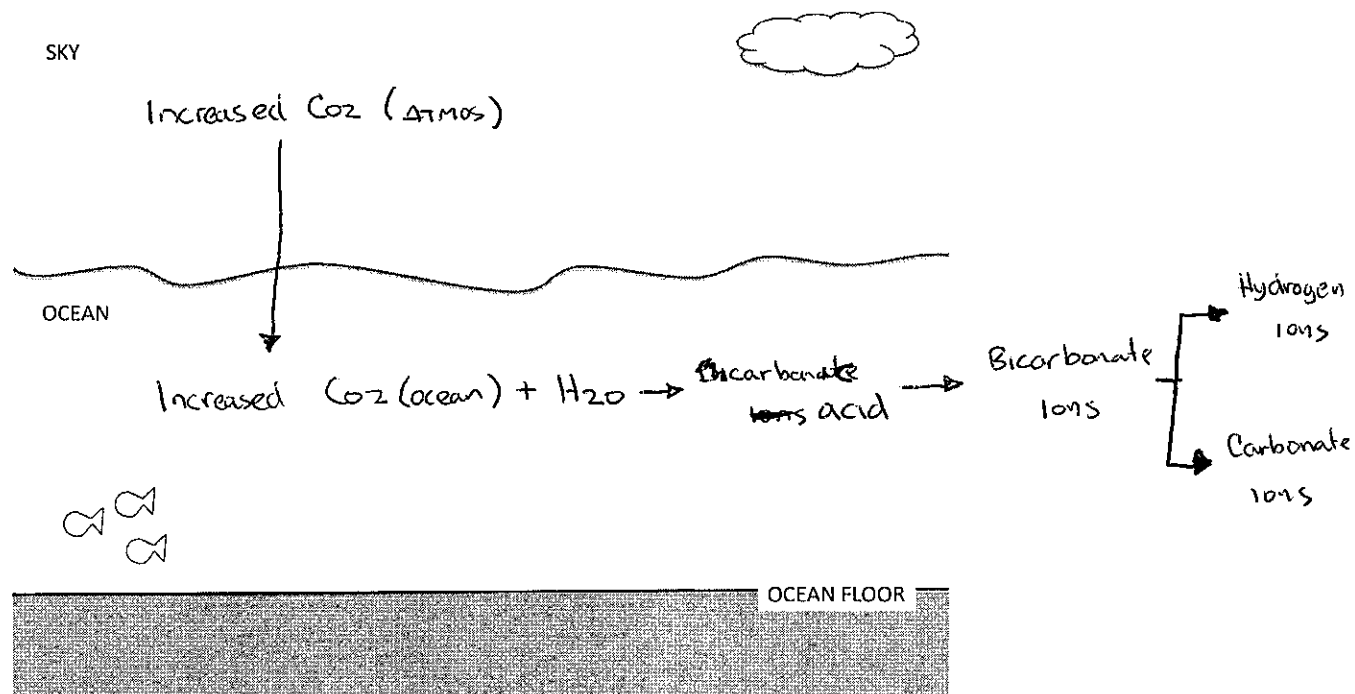
A43292970

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Higher temperature holds less CO_2 so it's less acidic.

Colder temperature holds more CO_2 so it's more acidic.

Less CO_2 means there are less ~~for~~ hydrogen ions forming, ~~to~~ which is a measurement of acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean temperature would increase as well, and because warmer temperature absorbs less CO_2 , the oceans would be less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 in the atmosphere would mean there is a chemical disequilibrium between CO_2 in atmosphere & the water, so CO_2 would move to the water to get back to equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Death of the biosphere. ☹

Certain organisms don't respond well to a small change in acidity and so ocean animals could die and we wouldn't have those animals to eat.

It would disrupt the environment & the food chain.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

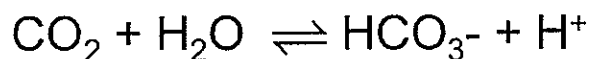
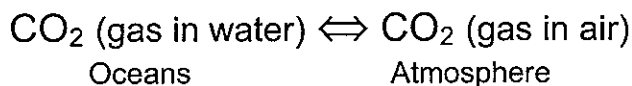
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

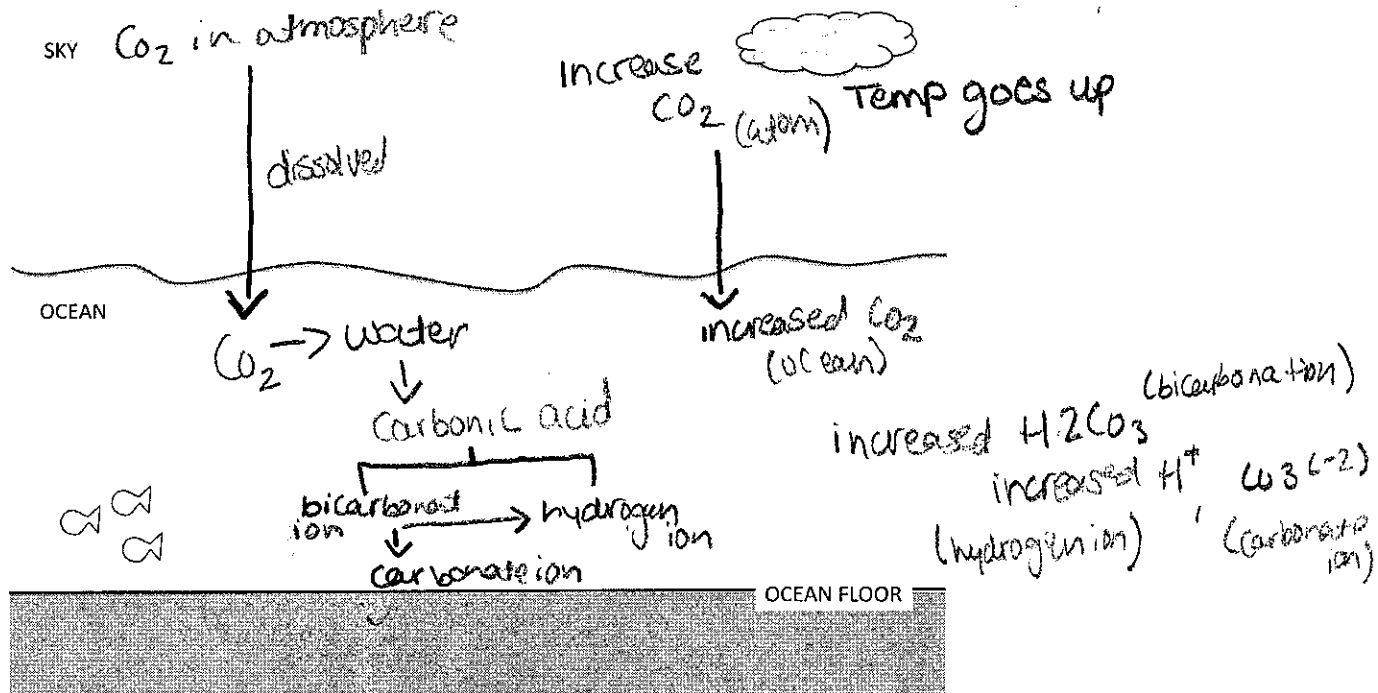
GROUP #: T
Student IDs of Members Present:
A39743811
A3973 7915
A42185423

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO_2 in the atmosphere
- Increased CO_2 in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO_2 in the atmosphere can cause changes in CO_2 in ocean water.

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water can hold more carbon dioxide. Carbon dioxide mixes with water creating carbonic acid which breaks down adding hydrogen ions to the water. More hydrogen ions in the water increases water acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean acidification would decrease because the ocean will be warming because there is more sun. This will result in less carbonic acid being created & less hydrogen ions. With less of these then there will be less acid.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

If the CO_2 increases then it could potentially lead to more carbonic acid being absorbed by the ocean water. It will increase the ocean acidification because the amount of hydrogen ions will increase causing higher acid.

D. Why do you think ocean acidification could be a problem for human society?

Oceans take CO_2 out of atmosphere leaving less for the plants meaning the plants will slow in their respiration, creating less oxygen in the atmosphere for humans.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?

CO₂ the atmosphere will increase & the oceans will become more acidic because the

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

GROUP #: X

Student IDs of Members Present:

A43398594

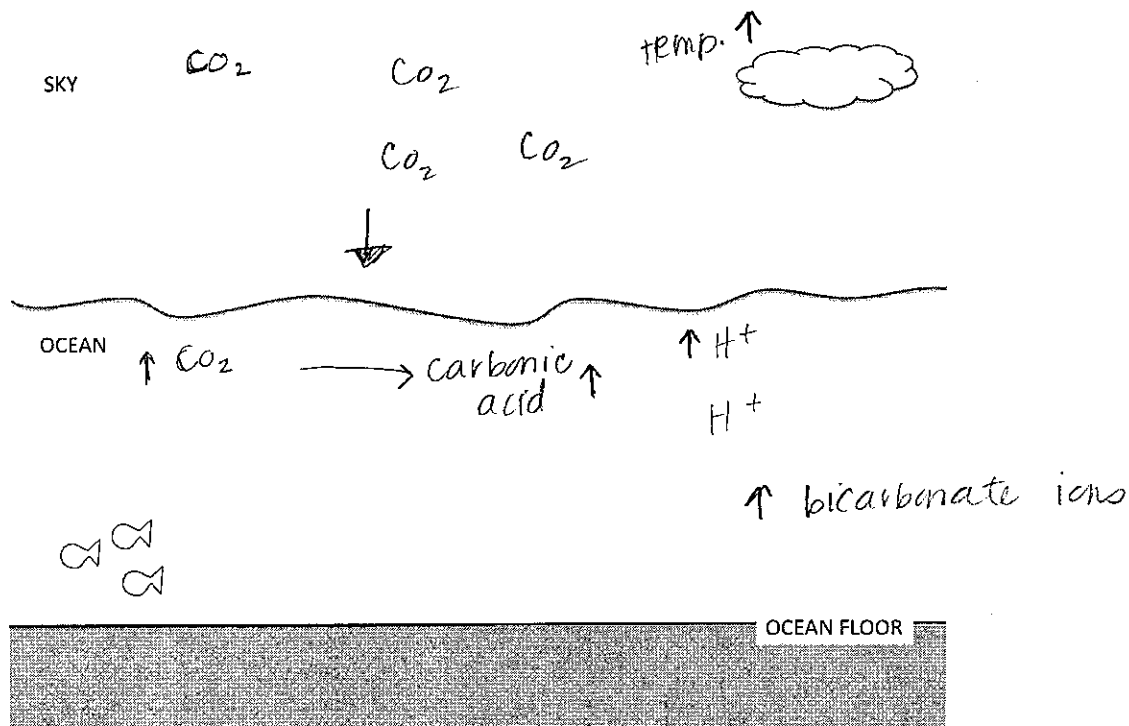
A43012134

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO_2 in the atmosphere
- Increased CO_2 in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO_2 in the atmosphere can cause changes in CO_2 in ocean water.

less CO_2 in atmosphere \downarrow , CO_2 in water goes into atmosphere

Group
X

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

↑ of temperature, less acidic, doesn't hold as much CO_2 - molecules move faster.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean would be less acidic because warmer temp. in atmosphere \Rightarrow less CO_2 in water.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 in atmosphere leads to more CO_2 in the water = more acid which breaks down to H^+ ions

D. Why do you think ocean acidification could be a problem for human society?

More acidity = more Hydrogen & bicarbonate ions, harder for shells to form, animals would be affected which affects our food chains

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

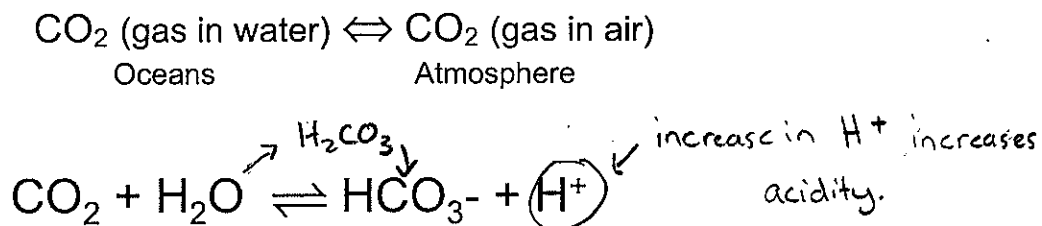
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

temp = measure of numt of molecules

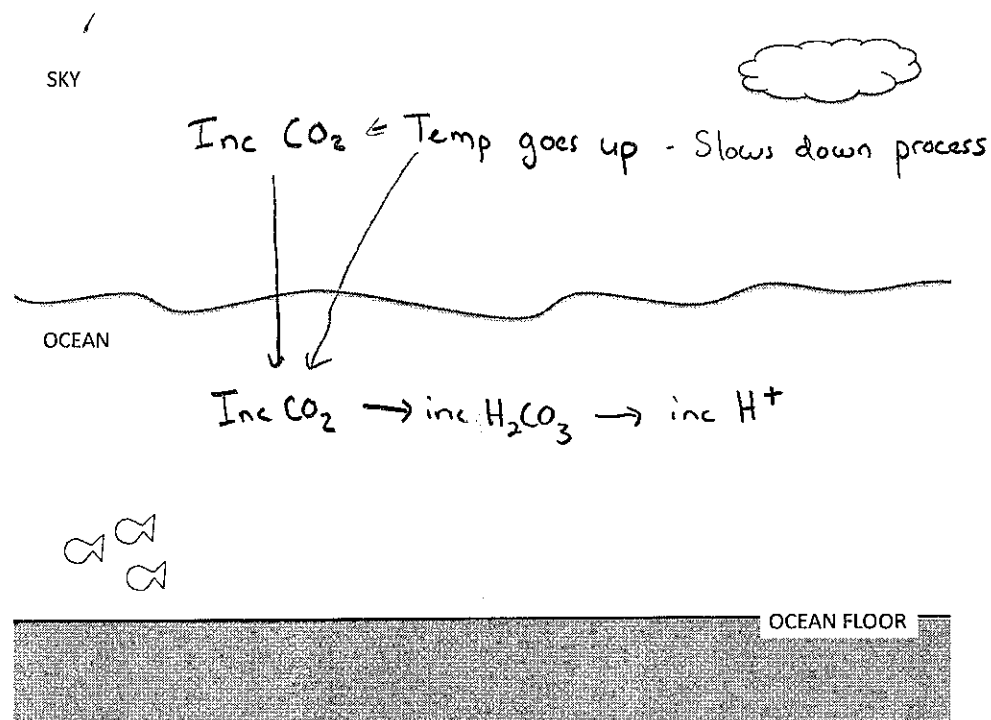
Cold water holds more gas - easier to fit in between.

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

CO₂ increases in atmosphere

More CO₂ diffuses in the water.

CO₂ in ocean becomes Carbonic Acid.

Carbonic Acid becomes H⁺ ions, (inc. acidity).



Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

Increase in temp makes it harder to hold CO_2 , since the molecules move slower, allowing for the CO_2 molecules to enter the water. This means there's less CO_2 reacting, to become H_2CO_3 , which becomes H^+ , meaning a reduction in acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Increasing the heat in the atmosphere means the ocean would also heat up, to maintain a thermal energy equilibrium between the two. This then makes the water molecules move faster, making it harder for water to hold CO_2 . This decrease in CO_2 decreases H^+ , making it less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

An increase in CO_2 in the atmosphere makes a chemical imbalance between the atmosphere and ocean. To get to equilibrium, more CO_2 will dissolve into the ocean from the atmosphere. $\rightarrow \text{inc } \text{H}_2\text{CO}_3 \rightarrow \text{inc } \text{H}^+$.

D. Why do you think ocean acidification could be a problem for human society?

All ocean lifeforms survive based on the acid level of the ocean. Human society relies on ocean lifeforms for food.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO_2 in atmosphere and increasing global temperatures can affect the acidity of the oceans.

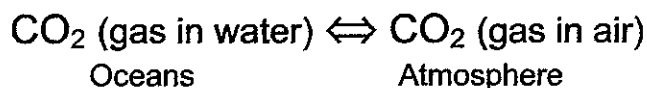
Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes

CO_2 doesn't break apart

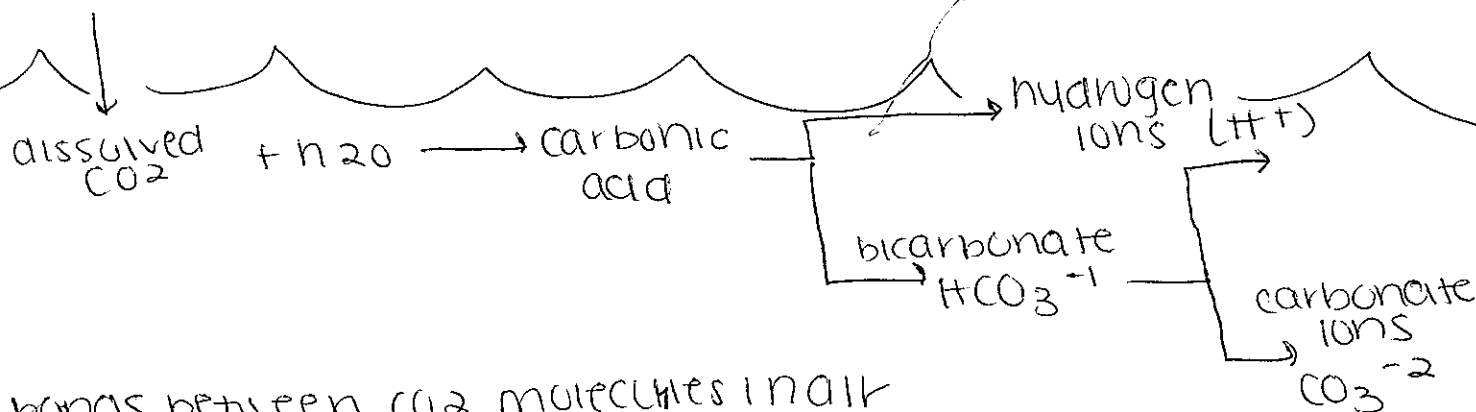
exam question



CO_2 in atmosphere to oceans

- with too much H^+ in ocean, great shells can't be formed.

1. Atmospheric CO_2



* no bonds between CO_2 molecules in air

↳ same when in water.

↳ like can, flat when CO_2 has leaked into atmosphere

- lower pH = more acidic
↳ more hydrogen ions.

1) in presence of H_2O carbon dioxide turns in carbonic acid

2) carbonic acid + water creates bicarbonate

3) bicarbonate with water = hydrogen

↳ carbonate

• cold water holds more gas than warm water

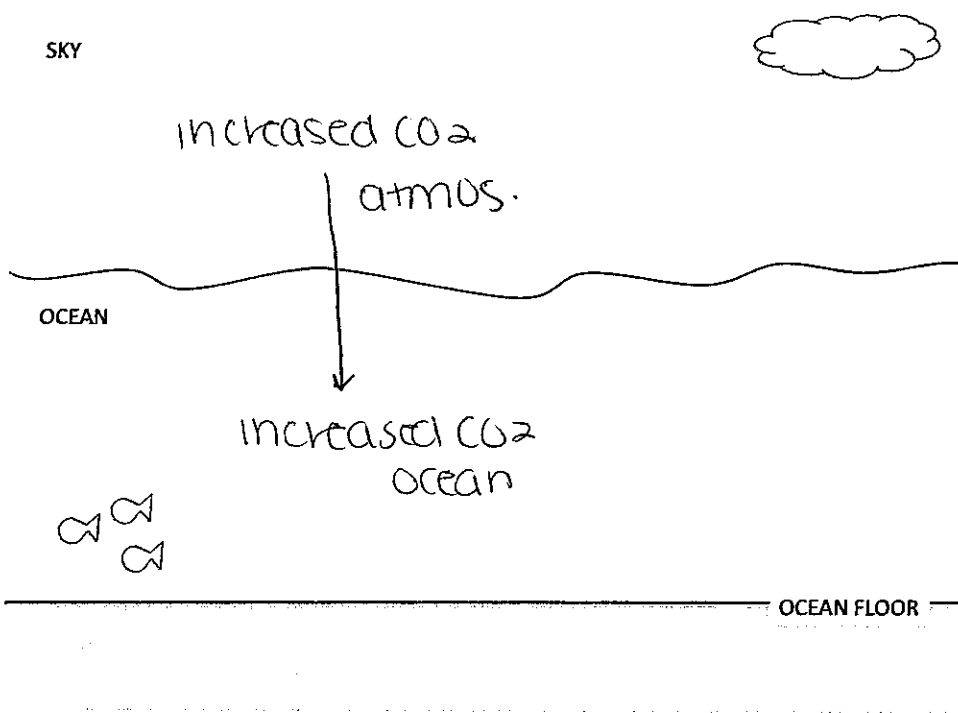
• increase in CO_2 in atmosphere = increase in ocean CO_2

Class Notes

On the diagram below, draw in each step occurring during ocean acidification.

Examples:

- Increased CO₂ in the atmosphere
- Increased CO₂ in the oceans
- Formation of hydrogen and bicarbonate ions



Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

When water is added to CO₂ it forms carbonic acid. Carbonic acid breaks down into hydrogen ions OR bicarbonate. The bicarbonate breaks down into either hydrogen OR carbonate.

increased CO₂
↳ increased H₂CO₃
↳ increased H⁺, CO₃⁽⁻²⁾

- ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

A. How does temperature of ocean water affect the acidity of the oceans?

colder temperature of water holds
more gas.

↳ higher temperature is less acidic,
less room for more molecules

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

CO₂ turns into acid

D. Why do you think ocean acidification could be a problem for human society?

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this effect the acidification of the oceans?

increase

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

decrease.

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2 <i>atmosphere</i>	More CO ₂ in air	More CO ₂ released into air
Impact of Increasing Weight 2 on Weight 1	More CO ₂ will dissolve into ocean	Strive to equilibrium
Increasing Distance 2	CO ₂ in atmosphere increased	Higher temp = higher concentration of CO ₂
Decreasing Distance 2	CO ₂ in atmosphere decreased	Lower temp = lower concentration CO ₂

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

System strives toward equilibrium. Increased amounts of CO₂ in atmosphere will cause increased amounts of CO₂ to dissolve in ocean.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water can absorb more CO_2 which would cause increased acidity. Hotter water temperatures absorb CO_2 at a slower rate decreasing the rate of acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Because a change in CO_2 levels is not a factor, ocean acidification would decrease because warmer water can not absorb as much CO_2 .

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because system strives towards equilibrium, more CO_2 will be entering the ocean to reach this balance.

D. Why do you think ocean acidification could be a problem for human society?

Because oceans with a higher acidity are harmful to biological systems which harms the foodchain.

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (gas in water)	
Weight 2	CO ₂ (gas in atmosphere)	
Fulcrum	Temperature of Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	increasing CO ₂ in atmosphere	
Impact of increasing Weight 2 on Weight 1	More CO ₂ in air dissolves into oceans More CO ₂ in oceans	
Fulcrum	Temperature changes the amount of dissolve CO ₂	

NOTES:

Warmer = less CO₂ it can hold

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

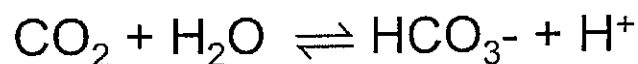
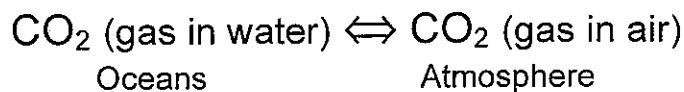
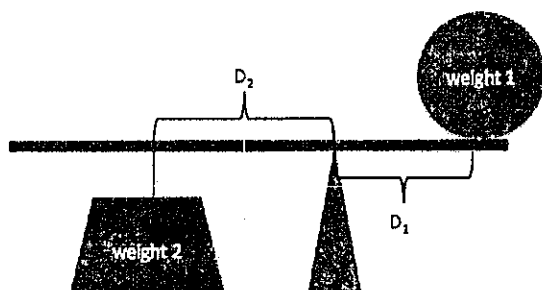
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

2

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	more CO ₂ in atmosphere	more weight means more CO ₂ in atmosphere
Impact of Increasing Weight 2 on Weight 1	more CO ₂ would dissolve into ocean	increasing amount of CO ₂ in atmosphere (weight 2), causes increase in CO ₂ in ocean (weight 1)
Increasing Distance 2	ocean gets colder	when distance increases just like CO ₂ increases in cold water
Decreasing Distance 2	Ocean gets warmer	when distance decreases just like CO ₂ decreases in warm water

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
weights, position of the weights, fulcrum	What causes changes in the system? Movement or change of matter or energy?	temperature, amount of CO ₂ in atmosphere

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

More CO₂ in the atmosphere means that more has to dissolve in the ocean for there to be equilibrium. However, an increase of CO₂ in the atmosphere would cause an increase in temperature of the atmosphere which would increase the temperature of the ocean which would mean less CO₂ could be dissolved.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

higher temperature = less CO_2 is dissolved = lower acidity

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean would get warmer, so less CO_2 would be dissolved, which means lower acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 in atmosphere means more CO_2 in oceans which would lead to higher acidification

D. Why do you think ocean acidification could be a problem for human society?

It could hurt the ocean life that we use for food.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

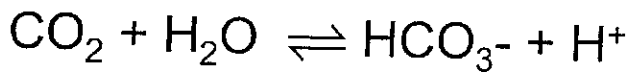
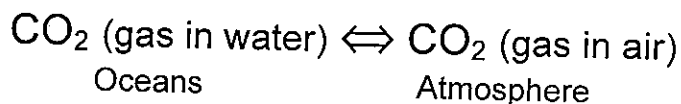
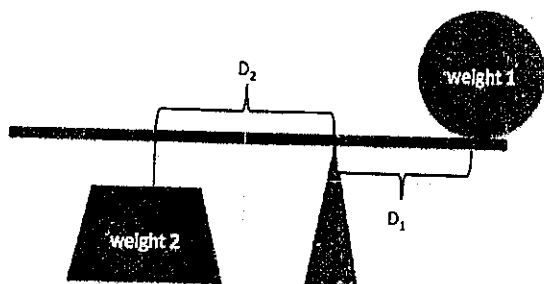
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

GROUP #: 3
Student IDs of Members Present:
A42405167
A42005463
A432016773

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (gas in water)	
Weight 2	CO ₂ (in atmosphere)	
Fulcrum	Temperature of ocean water	

→ If temp is low more exchange than expected

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	increase acidification	
Impact of increasing Weight 2 on Weight 1	more CO ₂ in the water	
Fulcrum	temp. changes amount of dissolved CO ₂	

more


NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	Increase in CO ₂ in the atmosphere	the systems are always attempting to reach
Impact of Increasing Weight 2 on Weight 1	Increase in CO ₂ in the water (oceans)	"equalibrium"
Increasing Distance 2	more CO ₂ in the atmosphere	
Decreasing Distance 2	less CO ₂ in the atmosphere	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	Chemical
equilibrium	What causes changes in the system? Movement or change of matter or energy?	equilibrium

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water. When there is an increase in CO₂ in the atmosphere more CO₂ then dissolves in the ocean in order to reach equalibrium. in the system,

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

When the temperature of the water is colder the water can dissolve more gas causing the ocean to be more acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would be slowed/less due to the warming of the oceans which then would dissolve less CO_2 .

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

If you increase carbon dioxide in the atmosphere in order to reach equilibrium more CO_2 would dissolve in the water.

D. Why do you think ocean acidification could be a problem for human society?

It could be a problem because the increase in CO_2 wouldn't be good for human society

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

Puts more carbon in the atmosphere
which would cause the oceans to become
more acidic

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

The acidity would decrease algae using
up the CO_2

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increasing CO ₂ in air	Gas in the atmosphere
Impact of Increasing Weight 2 on Weight 1	More CO ₂ in air more CO ₂ dissolved in oceans	CO ₂ in air must reach equilibrium with CO ₂ in oceans
Increasing Distance 2	increasing the amount of CO ₂ dissolved in the air	the higher the temp the less CO ₂ absorbed
Decreasing Distance 2	decreasing the temp and amount of CO ₂ dissolved in the air	the lower the temp the more CO ₂ absorbed.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Thermal energy
Distance	What causes changes in the system? Movement or change of matter or energy?	temp

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water. The amount of CO₂ in the atmosphere either increases or decreases the amount of CO₂ in the ocean because they must reach a state of equilibrium, because the CO₂ must dissolve into either one

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The higher the temp of ocean water the slower the process of absorbing CO_2 & holds less CO_2 which has less acidity. The lower the temp of ocean water the faster the process of absorbing CO_2 , and holds more CO_2 and more acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The warmer the temp, the warmer the water which slows down the absorbing process which means less CO_2 in the water and less acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increase CO_2 in atmosphere will lead to an increase of CO_2 in oceans because they will try to reach a state of equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

When the oceans have more carbon, they can't hold oxygen and so the organisms in the water start dying.

Imbalance of ocean acidification causes problems for the organisms in water and those that depend on them.



Objectives

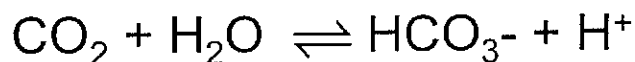
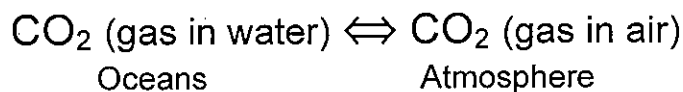
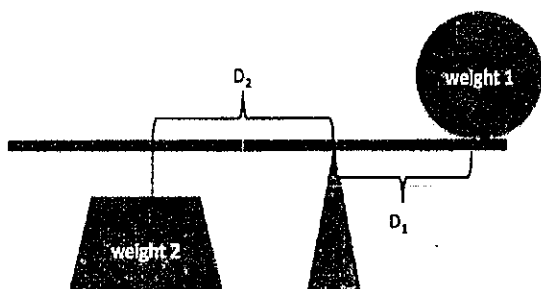
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions



GROUP #:
Student IDs of Members Present:

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2		
Impact of Increasing Weight 2 on Weight 1		
Increasing Distance 2		
Decreasing Distance 2		

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
	Type(s) of energy	
	What causes changes in the system? Movement or change of matter or energy?	

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

- A. How does temperature of ocean water affect the acidity of the oceans?
- B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?
- C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.
- D. Why do you think ocean acidification could be a problem for human society?

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



Objectives

Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.

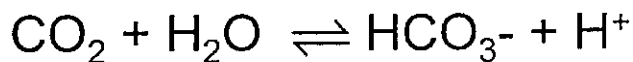
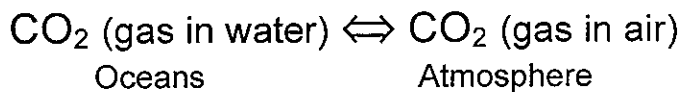
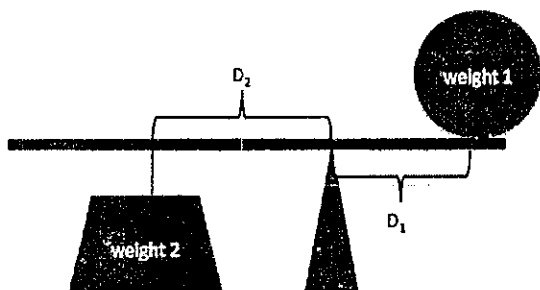
② A system is in **equilibrium** when energy in the system is balanced.

③ Matter moves and changes to return a system to **equilibrium**.

4. **Energy** is needed to break bonds and is released when bonds form.

5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

GROUP #: 6
Student IDs of Members Present:
A43763919 A42600065
A 39966164

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	gas in Water	Increase/decrease
Weight 2	gas in atmosphere	changes balance
Fulcrum	temperature of ocean water	Equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in air	Increase
Impact of increasing Weight 2 on Weight 1	more CO ₂ in air dissolves into ocean	Increase
Fulcrum	Temp changes amt of dissolved CO ₂	Equilibrium

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increase in atmosphere	increased
Impact of Increasing Weight 2 on Weight 1	CO ₂ from weight 2 dissolves, making weight 1 heavier	increases
Increasing Distance 2	transfer from 2 to 1 in order to achieve equilibrium	changes/transfers to achieve equilibrium
Decreasing Distance 2	transfer from 1 to 2 in order to achieve equilibrium	" "

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal & Gravitational
movement & change of energy	What causes changes in the system? Movement or change of matter or energy?	Movement & change of matter

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

The more CO₂ in the atmosphere there is, the more CO₂ there will be in ocean water because there must be a transfer of CO₂ molecules from the atmosphere to the ocean water in order to achieve equilibrium

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The hotter the ocean water, the less acidic it will be because the warm, moving H_2O molecules bounce the CO_2 molecules out.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Sunlight warms the earth, raising ocean temperature, causing H_2O molecules to move faster, bouncing CO_2 molecules out. Which causes the ocean to be less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 in atmosphere will need to be balanced w/ CO_2 levels in ocean water in order to achieve equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Too much ocean acidification would harm marine life, cause more acid rain (through evaporation) & drinking water would become too acidic to ingest.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

1.1

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

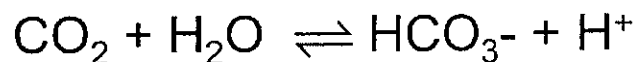
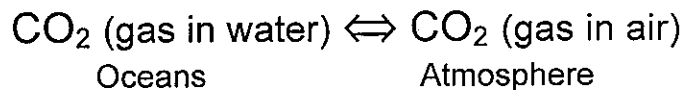
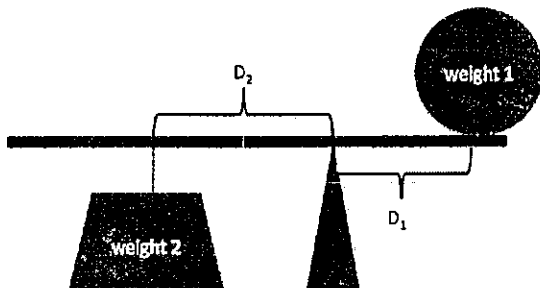
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ Gas in Water	
Weight 2	CO ₂ Gas in Atmosphere	
Fulcrum	Temperature of ocean Water	Exchanges between CO ₂

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	More CO ₂ in Air Adding CO₂ to atmosphere CO₂ from atmosphere to ocean	
Impact of increasing Weight 2 on Weight 1	More CO ₂ in air dissolved, More CO ₂ in ocean	
Fulcrum	Temperature changes the dissolved CO ₂	

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More CO ₂ in the air	Decrease distance of D ₂
Impact of Increasing Weight 2 on Weight 1	Less CO ₂ in the water	The weight distribution would be unequal
Increasing Distance 2	Less CO ₂ in the atmosphere	Decrease the weight to make equal
Decreasing Distance 2	Increase CO ₂ in the atmosphere	Increase the weight to make equal

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Equilibrium - Fe Weight	What causes changes in the system? Movement or change of matter or energy?	Equilibrium - Weight Temperature

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Increases or decreases of CO₂ in the atmosphere will cause increases or decreases of CO₂ in the ocean to maintain equilibrium.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water can absorb more CO_2 , so colder waters are more acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The oceans would become warmer and they would be able to hold less CO_2 (less acidic), so there would be more CO_2 in the atmosphere.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More carbon in the atmosphere will increase CO_2 in the ocean which will cause it to be more acidic.

D. Why do you think ocean acidification could be a problem for human society?

Organisms in the water (such as shellfish) would have greater problems protecting themselves from acidic water. Their shells could dissolve.

- it is a problem because it affects marine life and humans economically benefit from.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More gas in ocean	Decreasing of distance 2
Impact of Increasing Weight 2 on Weight 1	More CO ₂ in ocean dissolves into more CO ₂ in Air	Decrease of distance 2 while increase of distance 1
Increasing Distance 2	Decrease of CO ₂ in atmosphere	Decreasing of weight 2
Decreasing Distance 2	Increase of CO ₂ in atmosphere	Increasing of weight 2

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Chemical
Gas in water vs Gas in atmosphere	What causes changes in the system? Movement or change of matter or energy?	Increasing/decreasing of weights and distances from fulcrum

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

As CO₂ increases in the atmosphere, the temperature increases which increases the ocean temperature causing the process to slow down.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water would be more acidic than warmer water.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The process would slow down and making the ocean less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because it reaches equilibrium so more CO_2 would be put into the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Because we use the ocean for food supply and if it becomes too acidic we cannot consume organisms from the ocean.

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increase CO ₂	changes balance
Impact of Increasing Weight 2 on Weight 1	more CO ₂ in air and in ocean	drives toward equilibrium
Increasing Distance 2	decrease CO ₂	balance + equilibrium
Decreasing Distance 2	increase CO ₂	balance + equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	change of matter and/or energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Increasing CO₂ in the atmosphere increases the temperature of the atmosphere. This increases the temperature of the water less ~~more~~ CO₂ will be dissolved in the water ~~and the oceans will become less acidic.~~ and the oceans will become less acidic.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

If temperature is high, there will be ~~more~~ ^{less} exchange of CO_2 . This would mean that there is ~~less~~ ^{more} bicarbonate and H^+ ions in the oceans, which would make ~~less~~ ^{less} acidic but would also decrease the amount of CaCO_3 available for organisms to make shells from.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The higher the temperature, the less acidic; the lower the temperature the more acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increasing CO_2 increases temperature of the atmosphere. Increasing the temperature in the air increases the temperature of the ocean, which decreases the likelihood of ocean ~~acid~~ acidification.

D. Why do you think ocean acidification could be a problem for human society? ^{food chain}

This would be a problem because it could disrupt the marine food chains in the ocean. If organisms cannot function or build shells, they could die off and prevent other organisms from using them as food.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

Objectives

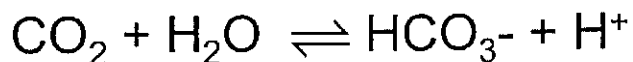
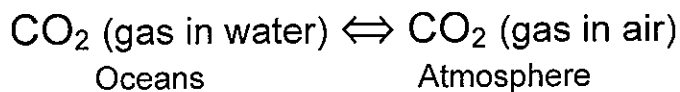
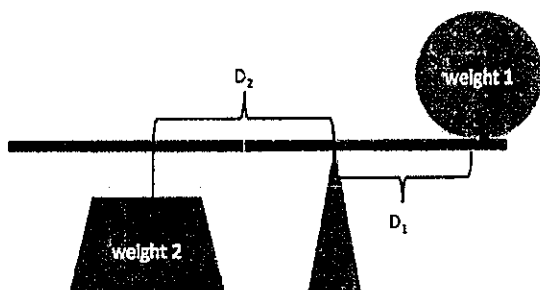
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
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PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (Gas in the water)	Increase / Decrease Balance
Weight 2	CO ₂ (Gas in the atmosphere)	
Fulcrum	Temperature of the Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	More CO ₂ in the Air	
Impact of increasing Weight 2 on Weight 1	More CO ₂ in air dissolves into the ocean	
Fulcrum	Temperature changes... the amount of CO ₂ in Air/Ocean	

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	Increase CO ₂ in atmosphere	Change balance of CO ₂
Impact of Increasing Weight 2 on Weight 1	Increase of CO ₂ dissolved in Ocean to balance out	Change balance of CO ₂
Increasing Distance 2	Decrease of CO ₂ in water	Change balance of CO ₂
Decreasing Distance 2	Increase of CO ₂ in water	Change balance of CO ₂

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational Energy	Type(s) of energy	Thermal Energy
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter/energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Changes in CO₂ in the atmosphere are constantly changing CO₂ levels in the ocean to reach equilibrium.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the temperature, the more acidity there will be in the oceans.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The warming atmosphere would increase ocean acidification.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increased carbon dioxide in the atmosphere results in increased carbon dioxide in the ocean because of equilibrium. This makes the ocean acidification levels rise.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could affect the entire biosphere and marine life in the oceans. This could affect human society.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Objectives

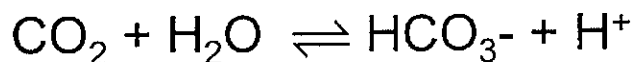
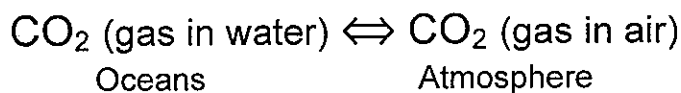
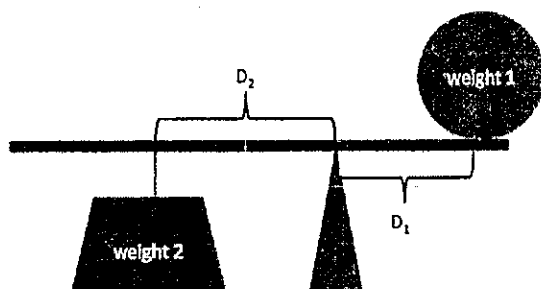
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- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (gas in water)	increase / decrease in Ocean / atmosphere
Weight 2	CO ₂ (gas in atmosphere)	
Fulcrum	temperature of ocean water	system in equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in air	
Impact of increasing Weight 2 on Weight 1	more CO ₂ in air dissolves in to ocean more CO ₂ in ocean	
Fulcrum	temperature changes the amount dissolved CO ₂	

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increase CO ₂ in ocean	increasing weight 2 will need a move in the fulcrum. an increase of CO ₂ in the ocean will cause change to get back to equilibrium
Impact of Increasing Weight 2 on Weight 1	increase CO ₂ in atmosphere ocean impact on atmosphere	you w. have to move weight one closer to the fulcrum to achieve equilibrium: ocean must balance
Increasing Distance 2	increase CO ₂ in atmosphere	increase weight 1, and will have to increase CO ₂ in ocean
Decreasing Distance 2	decrease increase CO ₂ in ocean	decrease weight 1, have to decrease CO₂ in ocean decrease increase CO ₂ in atmosphere

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic gravitation potential energy	Type(s) of energy	thermal energy
movement	What causes changes in the system? Movement or change of matter or energy?	movement change of matter

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If there is an increase of CO₂ in the atmosphere, more will be dissolved in the ocean. Because more dissolves in the ocean, the ocean will be more acidic

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

the warmer the water is, the more CO_2 gets
"bounced out." So the warmer the water, the
less acidic it is

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

the air would be warmer, causing the ocean
to increase in temperature, ~~the~~ resulting
in a decrease in acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 will dissolve into the ocean

D. Why do you think ocean acidification could be a problem for human society?

When the ocean is too acidic, organisms
cannot survive, affecting the food chain

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

Objectives

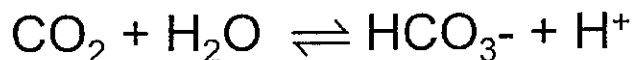
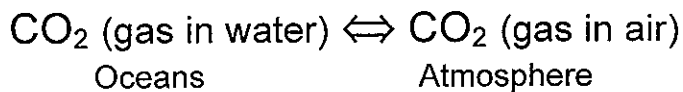
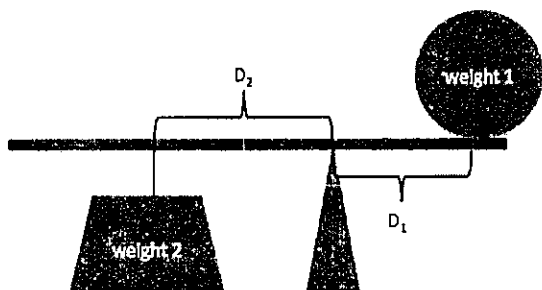
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

GROUP #:

Student IDs of Members Present:

A43506836

A40920866

A43272425

A43365634

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (gas in water)	
Weight 2	CO ₂ (gas in atmosphere)	
Fulcrum	temperature of ocean water	holds it in equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	Adding CO ₂ to atmosphere	increase changes balance
Impact of increasing Weight 2 on Weight 1	more CO ₂ in air, more CO ₂ in ocean	
Fulcrum	temperature changes amount of dissolved CO ₂	equilibrium

NOTES:



ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	Increase of CO ₂ in atmosphere	more CO ₂
Impact of Increasing Weight 2 on Weight 1	Increase of CO ₂ in oceans	more CO ₂ in atmosphere, more in oceans
Increasing Distance 2	decrease CO ₂ in atmosphere	equal weights must obtain equilibrium
Decreasing Distance 2	increase CO ₂ in atmosphere	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal, gravitational
Movement	What causes changes in the system? Movement or change of matter or energy?	change of energy (thermal) composition

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

CO₂ in the atmosphere strives to be in equilibrium with CO₂ in oceans, when one level shifts, so does the other

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Cold water can hold more molecules, acidity will increase

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Warm water cannot hold as much CO_2 as cold water, less CO_2 in oceans

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

CO_2 in the atmosphere strives to be in equilibrium with the ocean, increase CO_2 = increase acidity

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could be helped along by human activity that leads to global warming, water can fall out of tolerance range for fish and other animals that live in ocean. Food chain can be affected and ruined

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

Increase of run off

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

*Increase of algae = decrease CO_2
acidity of oceans ↓*

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Objectives

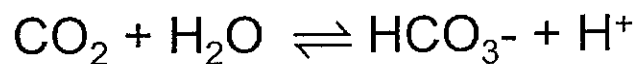
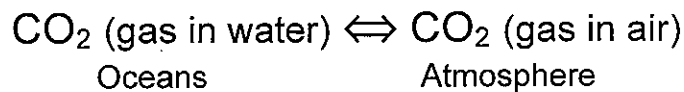
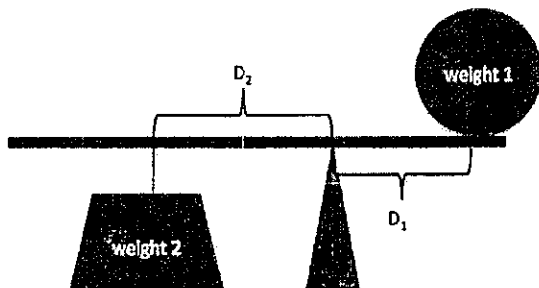
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ in water	
Weight 2	CO ₂ in Atmosphere	
Fulcrum	temp of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in air	
Impact of increasing Weight 2 on Weight 1	more CO ₂ in air dissolves into more CO ₂ in ocean	
Fulcrum	temp changes the amount of dissolved CO ₂	

NOTES:

increasing

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More CO ₂ in air	creates creates equilibrium
Impact of Increasing Weight 2 on Weight 1	More CO ₂ in air dissolves into oceans, more CO ₂ in ocean	equilibrium
Increasing Distance 2	decrease in CO ₂ in water increase in temp	increase in temp
Decreasing Distance 2	Increase CO ₂ in water decrease in temp	decrease in temp

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	thermal
Weight & Distance	What causes changes in the system? Movement or change of matter or energy?	temperature

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

It allows for more or less CO_2 to be dissolved in the oceans.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

It would heat up the ocean, causing less CO_2 to be dissolved in the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The more CO_2 in the atmosphere results in more CO_2 being dissolved in the oceans causing acidification.

D. Why do you think ocean acidification could be a problem for human society?

It affects ocean life, and that affects some of our food supply.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increasing CO ₂ in atmosphere	INCREASING / DECREASING AMOUNTS OF WEIGHT / CO ₂
Impact of Increasing Weight 2 on Weight 1	increase CO ₂ in water to reach equilibrium	
Increasing Distance 2	?	
Decreasing Distance 2	?	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Mechanical	Type(s) of energy	Thermal, gravitational
Movement of people as well as weight is what is causing changes in the system	What causes changes in the system? Movement or change of matter or energy?	Chemical reactions are occurring to change matter (H ₂ O) ions are being produced to make the water more acidic. Thermal energy results in colder water being able to

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in (cold) ocean water.

Changes in CO₂ in the atmosphere causes changes in CO₂ in the ocean water because the system is fighting to reach equilibrium.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

COLDER WATER CAN HOLD MORE CO₂ GAS BECAUSE THE WATER MOLECULES AREN'T MOVING AS FAST. THE CO₂ MOLECULES THEREFORE DON'T BOUNCE OUT.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

THE HOTTER THE ATMOSPHERE, THE HOTTER THE WATER. WITH HOTTER WATER, THE MOLECULES ARE MOVING MORE QUICKLY, SO THE CO₂ MOLECULES BOUNCE OUT. NOT AS MUCH ACIDIFICATION IN HOTTER WATERS.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

WITH AN INCREASE IN CARBON DIOXIDE IN THE ATMOSPHERE, THE CO₂ IN THE OCEAN WILL TRY TO REACH EQUILIBRIUM, THIS INCREASING THE AMOUNT OF OCEAN ACIDIFICATION.

D. Why do you think ocean acidification could be a problem for human society?

MORE OCEAN ACIDIFICATION WILL RESULT IN MORE CO₂ IN THE ATMOSPHERE WHICH CAN LEAD TO A WARMER GLOBAL CLIMATE WHICH CAN CAUSE MULTIPLE SERIOUS PROBLEMS. (GLOBAL WARMING.)

Objectives

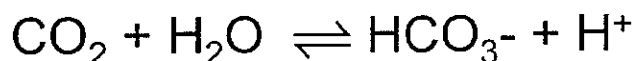
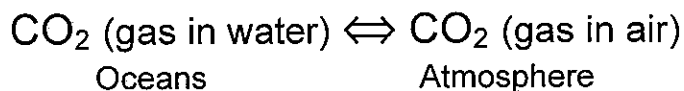
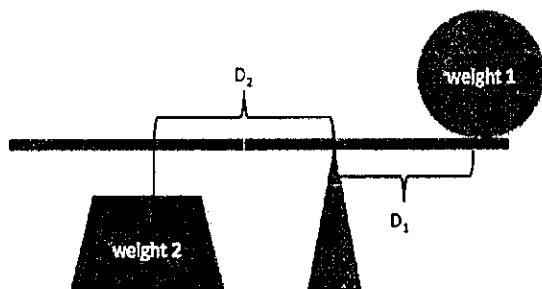
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (gas in water)	
Weight 2	CO ₂ (gas in atmosphere)	
Fulcrum	temperature of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	adding more CO₂ to the more CO ₂ in air from atmosphere to ocean	
Impact of increasing Weight 2 on Weight 1	more CO ₂ dissolves into ocean more CO ₂ in ocean	
Fulcrum	temp changes amount of dissolved CO ₂	

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	more CO ₂ in air ocean	as one increases, the other also increases
Impact of Increasing Weight 2 on Weight 1	CO ₂ in ocean evaporates into atmosphere	must balance by evaporating more into atmosphere
Increasing Distance 2	we can decrease weight 2	decreasing weight increase distant
Decreasing Distance 2	we can increase weight 2	decreasing weight increase distant

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

more CO₂ in the atmosphere causes more CO₂ in the ocean water

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

warmer ^{ocean} ~~ocean~~ → less acidification

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

ocean would warm up → less ocean acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because when CO_2 increases in air, the CO_2 condensates back to the ocean (increases in ocean acidification).

D. Why do you think ocean acidification could be a problem for human society?

Too much acid is harmful to humans

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

less CO₂ in atmosphere → less CO₂ in oceans

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

less CO₂ in atmosphere → less CO₂ in oceans

Objectives

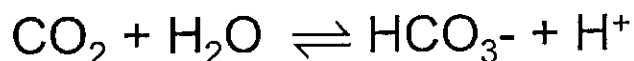
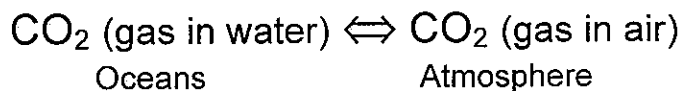
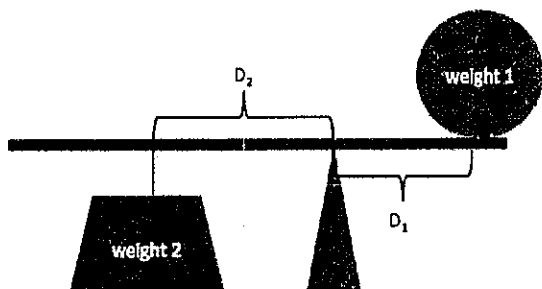
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

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Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

NOTES:

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Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increase CO ₂ in ocean	increasing
Impact of Increasing Weight 2 on Weight 1	↑ CO ₂ in ocean impact on atmosphere	move closer to equilibrium to obtain equilibrium
Increasing Distance 2	↑ CO ₂ in atmosphere	incr. weight 1
Decreasing Distance 2	↑ CO ₂ in ocean	decr. weight 2.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic Gravitational Potential	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	change of matter

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If there is an increase in CO₂ in the atmosphere there will be an increase of CO₂ in the ocean due to equilibrium

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The warmer the ocean water is the more CO₂ molecules get bounced out.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The air would be warmer and the water would be warmer and less CO₂ would be dissolved in the oceans.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

There would be more dissolved CO₂ in the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Increased acidification in the ocean will cause the deterioration of some organisms, which will cause problems within the food chain and will affect the availability of ocean foods that we commonly eat.

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Objectives

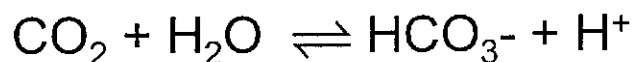
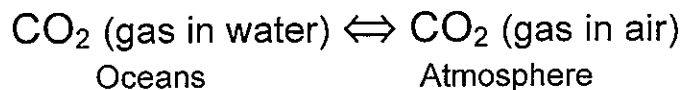
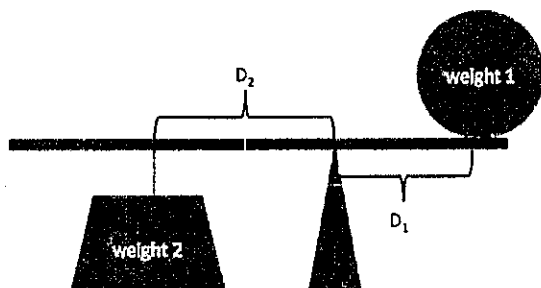
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ in water	
Weight 2	CO ₂ in atmosphere	
Fulcrum	Temp of Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in air	
Impact of increasing Weight 2 on Weight 1	more CO ₂ will dissolve in water	
Fulcrum	Temp changes lead to more acid	

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More CO ₂ in air	Affects CO ₂ levels
Impact of Increasing Weight 2 on Weight 1	More CO ₂ will dissolve in water	"
Increasing Distance 2	Equilibrium Decrease CO ₂ in water	"
Decreasing Distance 2	Increase CO ₂ in water	"

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Chemical energy Thermal energy
Weight, Δ of matter	What causes changes in the system? Movement or change of matter or energy?	Δ in energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

The balance of equilibrium will alter the CO₂ levels
in water and atmosphere

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the water the more acidic

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Higher temperatures mean more acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The CO_2 levels are affected by equilibrium. The CO_2 levels will naturally fix themselves for balance

D. Why do you think ocean acidification could be a problem for human society?

The oceans may become too acidic for fish or humans to be in the water

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

Group Work Questions:

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: - Energy started by ~~gravity~~ the pull of gravity

Thermal energy: - Energy created by the change in temp (Something getting hotter)

Chemical energy: - Energy created by the change in chemical composition

Buoyancy: - ~~the~~ materials gravitational pull changes based on density

Lithosphere: - Crust/Top of the asthenosphere

Asthenosphere: - soft bottom of lithosphere

Why Melting Occurs at Subduction Zones: add water to the right temp + pressure

MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When it cools the density will decrease and it will get colder causes the magma to harden as it reaches the surface

Crust warming:

At the crust. It because more warming that occurs with density crust. The more ~~dense~~ dense the crust will become. This adds more pressure to the asthenosphere under it so the lava can keep being created.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

They are both going to become magma at a certain temperature, but due to the density of the basaltic ocean crust, it would be less buoyant. Granite is ~~more~~ less dense than basalt, so even when its magma it will still be less dense.

████████████████████

████████████████████

18

Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Temp changes that cause density changes	Thermal
Differences in air inside and outside the balloon	differences in temp bet magma + rock	Booyancy / Thermal process
Balloon rising	magma rising	GRAVITATIONAL
Balloon floating	magma / rock TEMPS ARE EQUAL	Equilibrium
Outside air heating up during the day	pressure / Temp changes DUE TO DEPTH	

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature + Air pressure Density	Factors impacting density of balloon/magma	Density + Temp
Temp OF AIR	Factors impacting buoyancy	Temp of magma + rock + Density DUE TO DEPTH

Group Work Questions:

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy:

Thermal energy:

Chemical energy:

Buoyancy:

Lithosphere:

Asthenosphere:

Why Melting Occurs at Subduction Zones:

MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

Crust warming:

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

Objectives

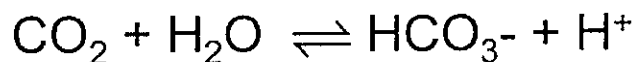
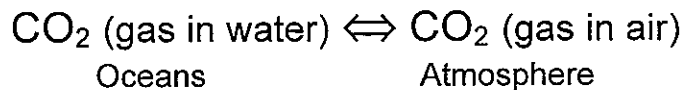
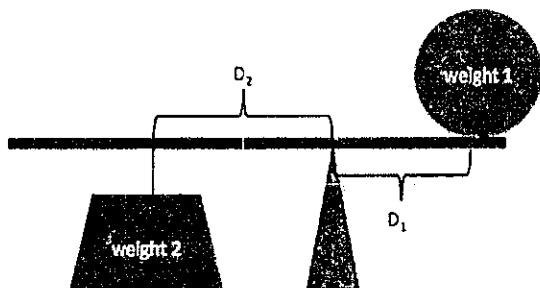
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	CO ₂ (GAS IN WATER)	
Weight 2	CO ₂ (GAS IN ATMOSPHERE)	
Fulcrum	TEMPERATURE OF OCEAN WATER	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	INCREASING PRECIPITATION OF CO ₂ IN OCEAN.	
Impact of increasing Weight 2 on Weight 1	MORE CO ₂ IN AIR DISSOLVES INTO OCEAN. MORE CO ₂ IN OCEANS.	
Fulcrum	TEMP. CHANGES THE AMOUNT OF DISSOLVED CO ₂ .	

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	INCREASING CO ₂ IN ATMOSPHERE.	BOTH ARE INCREASING, CAUSING IMBALANCE.
Impact of Increasing Weight 2 on Weight 1	MORE CO ₂ IN ATMOSPHERE MEANS MORE CO ₂ DISSOLVES IN OCEANS.	INCREASING ONE SIDE OF EITHER SYSTEM WILL CAUSE A NEED TO INCREASE THE OTHER.
Increasing Distance 2	LESS CO ₂ IN ATMOSPHERE TO BRING SYSTEM BACK INTO EQUILIBRIUM.	LESS IS REQUIRED TO BRING SYSTEM TO EQUILIBRIUM.
Decreasing Distance 2	MORE CO ₂ IN ATMOSPHERE TO FURTHER UNBALANCE OCEAN & AIR CO ₂ LEVELS.	MORE IS REQUIRED TO BRING SYSTEM TO EQUILIBRIUM.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
GRAVITATIONAL	Type(s) of energy	CHEMICAL & (MOSTLY) THERMAL.
INCREASING OR DECREASING WEIGHT &/OR DISTANCE ON EQUILIBRIUM.	What causes changes in the system? Movement or change of matter or energy?	CHEMICAL REACTION & MOLECULAR MOVEMENT. INCREASING ^{↓ for DECREASING} CHEMICAL &/OR THERMAL ENERGY.

CHANGES IN GRAVITATIONAL POTENTIAL ENERGY!

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

It all comes down to equilibrium. If there is more CO₂ in the atmosphere, to reach equilibrium more CO₂ will have to dissolve from the atmosphere into the ocean. If there is less CO₂ in the ~~ocean~~ atmosphere, more CO₂ will degas from the oceans.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

If the water is colder, more CO_2 will dissolve into it.

If it's warmer, less CO_2 will dissolve into it.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would decrease.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

This would occur as a result of the system reaching equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Higher acidification will kill off corals and many other animals in the ocean. Algae being about the only thing that would live in an environment most of the ocean would be covered in a nasty algae bloom (maybe), and a lot of food sources would die off. Doubtless that would negatively affect ecosystems on land, too.



Objectives

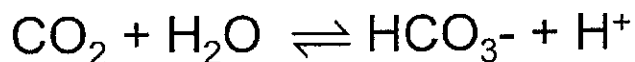
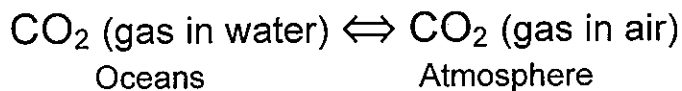
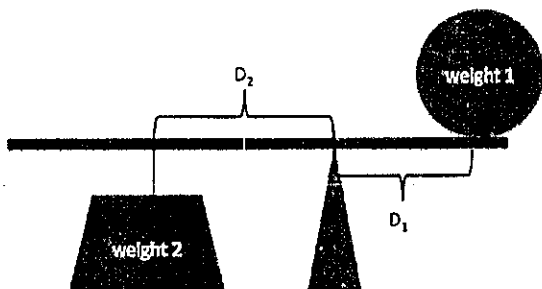
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increasing CO ₂ in the atmosphere	increase the balance
Impact of Increasing Weight 2 on Weight 1	increasing CO ₂ in atmosphere increasing CO ₂ in water to a certain point	increase/decrease the balance
Increasing Distance 2	increase in Temp.	slows up process
Decreasing Distance 2	decrease in Temp.	speeds up process

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational Potential	Type(s) of energy	Thermal
Movement in Matter	What causes changes in the system? Movement or change of matter or energy?	change in Energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If there is an increase of CO₂ in atmosphere, there is an increase in of CO₂ in the water... but only to a certain extend. With more CO₂, the temp. of water increases, not allowing as much CO₂.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

higher temp. slows process, decreasing acidity
and vice versa

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Decrease acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More hydrogen ions

D. Why do you think ocean acidification could be a problem for human society?

There will be more carbon dioxide and humans live off
of oxygen

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

21

Objectives

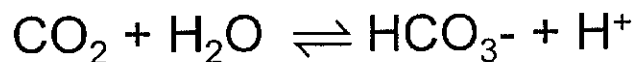
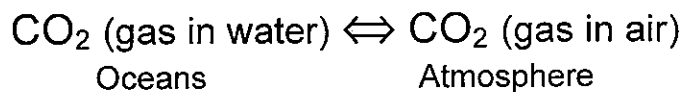
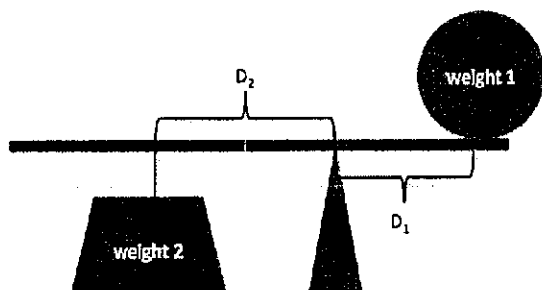
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in atm	
Impact of increasing Weight 2 on Weight 1	more CO ₂ in ocean	
Fulcrum	Temp changes amount of CO ₂	

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	increase CO ₂ in Atmosphere	changes balance
Impact of Increasing Weight 2 on Weight 1	increase CO ₂ in Ocean	changes equilibrium
Increasing Distance 2	Decreases water temp increase ocean CO ₂	changes temperature
Decreasing Distance 2	Increase water temp decrease ocean CO ₂	Increases temperature

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Equilibrium
Weight and distance	What causes changes in the system? Movement or change of matter or energy?	Temperature

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

CO₂ in atmosphere is proportionate to CO₂ in oceans depending on Temp.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The lower the Temp, the higher the CO_2 .

The higher the CO_2 the higher the Acidity

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



2d

A42829869

A42839439

A41729348

A37669797

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More CO ₂ in Air	add CO ₂
Impact of Increasing Weight 2 on Weight 1	More CO ₂ in air dissolves into ocean	add CO ₂
Increasing Distance 2	Decrease Weight 2	affects equilibrium
Decreasing Distance 2	Increasing Weight 2	affects equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
Movement and change of matter	What causes changes in the system? Movement or change of matter or energy?	Change of matter and energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If you increase CO₂ in atmosphere you increase CO₂ in the Ocean.

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

If the temperature of ocean is High it absorbs less CO_2 , therefore the water won't be as acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean acidification would decrease because the Temp would increase from the increase of the Temp of atmosphere.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

If you increase CO_2 in atmosphere the CO_2 in ocean would increase because it has to reach equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

We wouldn't be able to go swimming and also it would increase the greenhouse affect. Oh and bad for our drinking water

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

group 23

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2 atm	increasing CO ₂ in atmosphere	more CO ₂ in atmosphere & ocean
Impact of Increasing Weight 2 on Weight 1	more CO ₂ in water more acid in ocean	more CO ₂ in water means more acid in ocean
Increasing Distance 2	decrease CO ₂ in atm & stay in equil.	increase temp in atm increases ocean temp.
Decreasing Distance 2	increase CO ₂ in atm to stay in equil.	decrease temp. in atm. decreases ocean temp.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter/energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

more CO₂ in the atm means that
more CO₂ will go into the ocean to
reach equilibrium.

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

lower temp. means more CO_2 in the water, which increase Hydrogen ions \therefore increase in acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

~~the~~ warming the atm would cause the ocean to warm as well. This results in less CO_2 and less acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

more CO_2 in the atm results in increase ocean acidification because the ocean reaches equilibrium by allowing more CO_2 , increasing acidity.

D. Why do you think ocean acidification could be a problem for human society?

If the ocean has too much acidity, it can mess up the ecosystem by killing organisms that live there.

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	more CO ₂ in air	increase CO ₂ in the air
Impact of Increasing Weight 2 on Weight 1	more CO ₂ in air dissolves in ocean, therefore more CO ₂ in ocean	increase CO ₂ in air, ocean absorbs more CO ₂ & release CO ₂ to achieve equilibrium.
Increasing Distance 2	decrease the weight	increased temp. less CO ₂ in air.
Decreasing Distance 2	increase weight	decrease temp more CO ₂ in air.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal & chemical
changes in weight & distance causes changes in equilibrium.	What causes changes in the system? Movement or change of matter or energy?	changes in temperature causes changes in the system.

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

If there is more CO₂ in the atmosphere it will be released more into the ocean, to achieve the equilibrium in the both systems. And if there is more CO₂ in ocean it will degas into atmosphere to achieve equilibrium. The two systems will go back & forth to keep the equilibrium

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The higher temperature less carbon dioxide enters the water, because of the fast molecule vibration. And vice versa.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If the atmosphere is warmer that means the ocean is warmer. So the carbon dioxide enters the water slower; the acidification process is slower.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because ~~can~~ when carbon dioxide in the atmosphere adds up with water it creates carbon acid, causing water acidification in the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Higher level of ocean acidification will harm the ocean organism life; since it will deform the organisms. The food chain, & increased amount of carbon dioxide in limestone, affects the climate.

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

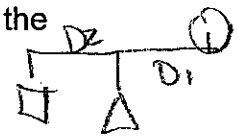


Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	more CO ₂ in air	Increases
Impact of Increasing Weight 2 on Weight 1	more CO ₂ in air dissolves in ocean	Increases
Increasing Distance 2	CO ₂ decreases in ocean so temperature increases	Increases
Decreasing Distance 2	CO ₂ increases in ocean so temperature decreases	Increases

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic Mechanical	Type(s) of energy	Chemical Thermal
weight	What causes changes in the system? Movement or change of matter or energy?	Temperature Density

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

CO₂ in the atmosphere and ocean are at an equilibrium. Therefore, if there is a change in the amount in the atmosphere it will disrupt the equilibrium and the ocean will be thrown out of balance.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

The temperature of the ocean water affects how much CO_2 can be transferred between water and air. This will

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If the Earth's atmosphere temperature increased the ocean acidification would increase because the transfer of CO_2 between air and ocean would decrease leaving more CO_2 to degas in the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The increase in CO_2 in atmosphere will increase ocean acidification the CO_2 degasses in the ocean to try and reach an equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could cause a decrease of food in the oceans and could effect the quality of getting water from the oceans. Also it could lead to an increase in CO_2 in the atmosphere which will increase Earth's temperature and change everything.

Objectives

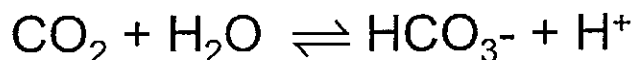
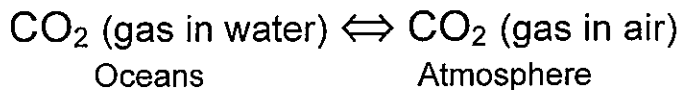
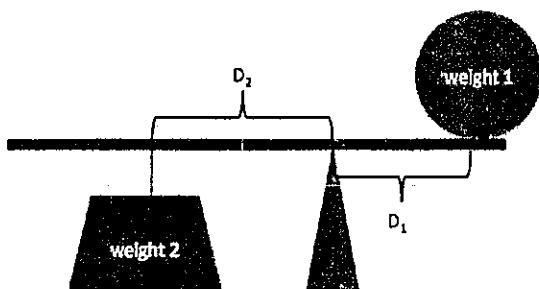
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

GROUP #: **26**
Student IDs of Members Present:
A39872700
A42003289
A40850791 A42707740

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	Increase of CO ₂	Increase
Impact of Increasing Weight 2 on Weight 1	Increases CO ₂ in oceans	Increase
Increasing Distance 2	changes CO ₂	Changes
Decreasing Distance 2	↓	↓

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	thermal & chemical
Movement & matter change	What causes changes in the system? Movement or change of matter or energy?	Movement

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Equilibrium is constantly being achieved, therefore if we increase CO₂ in one reservoir (atmosphere) it will slowly transfer to the ocean to reach equilibrium and vice versa.

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

A lower temperature means there is more CO_2 in the water, CO_2 ~~present~~ rises the pH (acidity) levels ~~from rising~~ ^{higher}, so in effect colder water has a ~~lower~~ ^{higher} acidity & vice versa with warm water.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

It would increase the temp of water & ~~the~~ ^{decrease} acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

would lead to more CO_2 in ocean which would result in more acid due to chemical process that leads CO_2 to carbonate molecules.

D. Why do you think ocean acidification could be a problem for human society?

Less diversity in oceans would result in an affect in the food chain. Precipitation would also be more acidic which could affects crops.

ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

Objectives

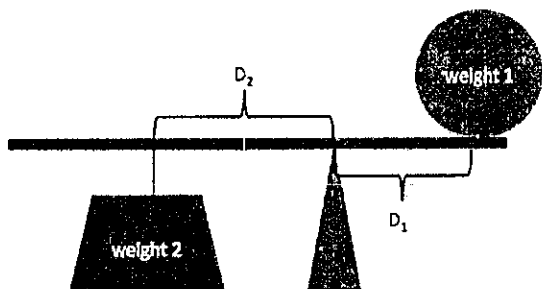
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO₂ in atmosphere and increasing global temperatures can affect the acidity of the oceans.

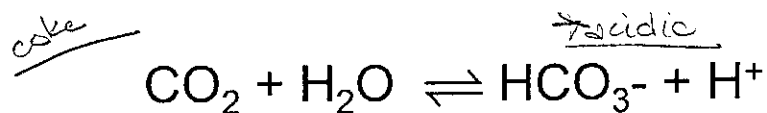
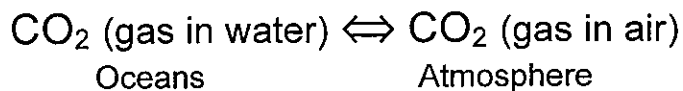
Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
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4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

PART 1: Background Notes



* cold water can absorb MORE CO₂. Higher temps Slow process. Lower temps Quickens process.



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

GROUP #:

Student IDs of Members Present:

A40967142
A42667614
A40704999
A42422266

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	gas in water	
Weight 2	gas in atmosphere	
Fulcrum	temp of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO ₂ in air	increase in oranges
Impact of increasing Weight 2 on Weight 1	more CO ₂ in air dissolves into oceans more CO ₂ in ocean	
Fulcrum	temp changes the amt of dissolved CO ₂	

NOTES:

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	Increasing CO ₂ in atmos.	Both increase (direct analogy)
Impact of Increasing Weight 2 on Weight 1	Increases CO ₂ in ocean	Both increase (direct analogy)
Increasing Distance 2	increasing temperature of atmosphere	Both increase (direct analogy)
Decreasing Distance 2	decreasing temperature of atmosphere	Both decrease (direct analogy)

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Chemical
Adding more weight	What causes changes in the system? Movement or change of matter or energy?	Changing temperature (Thermal Energy)

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

The equilibrium will change and so in order to balance out, CO₂ in the water will also change.

If CO₂ in atmosphere increases, so will CO₂ in water.

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Temperature affects density and therefore can increase or decrease acidity. Colder water can absorb more gas

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If temperatures rise, water will not be able to absorb as much CO_2 which will decrease acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

A system seeks equilibrium so if there is more CO_2 in the atmosphere, water will absorb CO_2

D. Why do you think ocean acidification could be a problem for human society?

Too much acidity changes organisms which will affect human society

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

28

A40678097

A43836396

A41930966

A41836115

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More in air	Both are increasing
Impact of Increasing Weight 2 on Weight 1	More in water, starts to dissolve	Works to "even out"
Increasing Distance 2	Higher temperature - less CO ₂ in water	Effects equilibrium
Decreasing Distance 2	Lower temperature - more CO ₂ in water	Effects equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal / Chemical
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter of energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

More CO₂ in the atmosphere increases temperature, higher temperature decreases CO₂ in the water

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water is more acidic because it can hold more CO_2 .

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

More CO_2 in air is dissolved, which means less CO_2 in ocean, because of the high temperature.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More CO_2 in the atmosphere means there's more in the water due to equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Excess CO_2 is the changing of the chemistry of the sea & providing harmful for many forms of marine life, a more acidic ocean can wipe out species.

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	CO ₂ added in atmosphere and ocean	Both adding CO ₂
Impact of Increasing Weight 2 on Weight 1	CO ₂ increased in ocean	Both adding CO ₂
Increasing Distance 2	CO ₂ added in atmosphere, less in oceans	Redistribute how CO ₂ is between ocean and atmosphere.
Decreasing Distance 2	CO ₂ taken away from atmosphere, more in oceans	Redistribute how CO ₂ is between ocean and atmosphere

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal / Chemical
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter / energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

Decrease in CO₂ in ocean water causes the amount that is degassed into the atmosphere. If CO₂ is increased in atmosphere, CO₂ in oceans increase. Which causes temperature in atmosphere to increase, causing ocean water to increase, lessening amount of CO₂ in oceans because of degassing.

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

If you increase temperature, CO_2 increases, which increases acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would increase

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The amount of CO_2 in air will be in equilibrium of the amount of CO_2 in ocean, if increased, in air, it will be increased in ocean.

D. Why do you think ocean acidification could be a problem for human society?

The shells in the oceans will be destroyed, which is a main food source for fish, killing them off, and destroying natural habitat in ocean

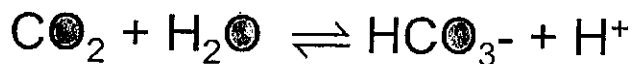
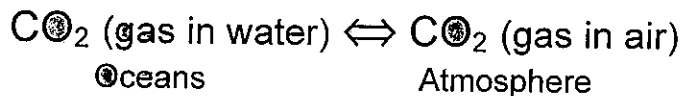
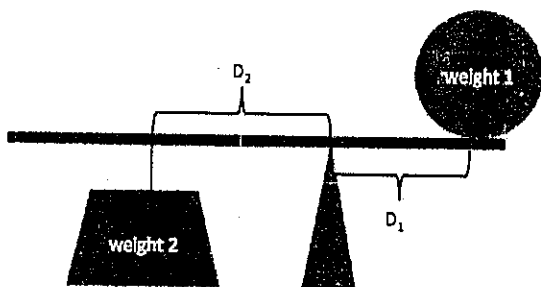
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Upon completion of this activity, you will:

- ## Causal Principles

- ## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

ISP203A Global Change
Chemical Equilibrium & Ocean Acidification

GROUP #:
Student IDs of Members Present:

Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO₂ in the Ocean/Atmosphere

See Saw	CO ₂	How related?
Weight 1	gas in water	
Weight 2	gas in atmosphere	
Fulcrum	Temp. of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	adding CO ₂ in the atmosphere	changes the equilibrium
Impact of increasing Weight 2 on Weight 1	More CO ₂ in air dissolves into ocean	
Fulcrum	temperature changes	system is in the equilibrium

NOTES:

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO₂ in the atmosphere causes changes to CO₂ in the ocean.

Table C. Changes in CO₂ and relation to see saw analogy

See Saw	CO ₂	How Related?
Increasing Weight 2	More CO ₂ in the air	It changes the equilibrium
Impact of Increasing Weight 2 on Weight 1	More CO ₂ in the air causes more CO ₂ to be dissolved in the ocean.	Change on both side is needed for equilibrium to be reached.
Increasing Distance 2	Increase in temperature	The fulcrum is the extra variable like temperature that affects the equilibrium.
Decreasing Distance 2	Decrease in temperature	" ↓ ↓ "

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter or energy

Explain in words how changes in CO₂ in the atmosphere can cause changes in CO₂ in ocean water.

The more CO₂ there is in the atmosphere will cause more CO₂ to be dissolved into the ocean to reach equilibrium.

ISP203A – Global Change
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

As temperature increases acidity decreases.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The water temperature would increase causing ocean acidification to decrease.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increasing CO_2 in the atmosphere causes an imbalance, so to reach equilibrium the CO_2 in the atmosphere would dissolve into the ocean, increasing ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

To little acidification would cause a decrease in calcium. To much acidification deform shells made.